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PROCEEDINGS OF
THE LINNEAN SOCIETY OF LONDON

148th Session (1935–6) Part 1

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1935

THE LINNEAN SOCIETY OF LONDON

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PROCEEDINGS OF

THE LINNEAN SOCIETY OF LONDON

(ONE HUNDRED AND FORTY-EIGHTH SESSION
1935–6)

GENERAL MEETINGS

24 October 1935

Dr. W. T. Calman, C.B., F.R.S., President,
in the Chair

The Proceedings of the Anniversary Meeting held on Thursday, 24 May 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted :—Reginald Akroyd.

Certificates of recommendation of the following candidates for Fellowship were read :—For the first time, in favour of William Watt Addison Phillips, Hampton Wildman Parker, William Albert Setchell, Atulananda Das, the Rev. Father Thomas Paris, John Walker Walton, Harold Downes, John Evan Adlard, Hirendra Kumar Nandi and James Harold Turner.

The President reported the deaths of Miss Ida M. Roper, D. H. E. Sunder, R. W. Scully, John Kitching and Dr. C. C. Gibbes, Fellows ; J. T. Cunningham, a former Fellow ; and Prof. F. A. F. C. Went and Prof. B. L. Robinson, Foreign Members.

Scientific results of the Cambridge Expedition to the East African lakes, 1930–1.—No. 15. The fish of Lake Rudolf and Lake Baringo. By Dr. E. B. WORTHINGTON and Miss C. K. RICARDO. [Abstract.]

THE paper under this title, which is for publication in the Journal of the Society, contains a mass of data extracted from the log books of the Cambridge Expedition of 1930–1, and also certain conclusions on the distribution of fish, on the ecology of the lakes, and kindred subjects.

The summary printed here is not of the paper in the Journal, but is intended to draw attention to certain wider issues which are involved in the study of African fish and the biology of equatorial lakes.

All the inland waters of Africa are certain to be of importance in the future in the production of fish for human food. Hence the study of fisheries is closely linked with that of the nutrition of African natives, which presents one of the largest problems facing the future of the whole African continent. Disease and malnutrition are together holding back the forward advance of the native, both in physique and in mental development, and as medical research proceeds more and more diseases are found to depend, directly or indirectly, on nutrition. In the region of the great lakes the most prominent food deficiencies, which have been proved to affect the natives' health, are proteins, calcium and, to a less extent, iodine. These deficiencies could be made good over wide areas if the potential supplies of fish are made available.

There is always grave danger of fisheries being started in the wrong way ; for example, overfishing may begin almost immediately or the wrong kind of fish may be chosen as the principal article of trade, perhaps a microphagous species which is an essential link in the food chains of the lake in question. Many such factors may lead to an upset of the natural balance, and therefore it is all-important to have a sound knowledge of the fauna, flora and ecology before exploitation starts. A series of papers bringing up to date such knowledge as exists on all the great lakes of East Africa is now nearing completion.

The first stage in such work is, of course, the study of systematics, and this has involved describing many new species and lumping others together. Since fish are such plastic animals, the old system of one or two type-specimens must be superseded by series of twenty or thirty type-specimens to cover the whole range of variation for each species. This involves skill in collecting, particularly since many of the larger species are impossible to preserve as adults, so that systematic descriptions must be drawn up in the field.

As a second stage in the work, many hundreds of individual fish of each species must be examined, and complete records must be made of their size, weight, stomach contents and genital developments. It is only when such data have been analysed statistically, and when other observations on life-histories, habitats and habits have been made, that it is possible to piece together the food chains and species associations, and to estimate the fish resources. A study of native fishing methods, many of which show a keen understanding of the fauna and ecology, can often help in these later stages of the work.

The final object, therefore, is to point the way to the efficient use of these natural resources by mankind, particularly by the natives of Africa, but in the course of study many subjects of more academic interest have come to light. Much information has been collected, for instance, on the chemistry, physics and bionomics of tropical lakes, and interesting comparisons can be made with the results of limnology in temperate latitudes. Systematic studies are leading to an understanding of specific differentiation, not only under the influence of isolation, but also where no geographical barriers exist. The Nile perch (*Lates niloticus* L.), for instance, has divided into two subspecies in Lake Rudolf, one very large, frequenting the inshore environment, and the other, quite small, in the deep water. The same has occurred in Lake Albert, where, however, the two forms are not identical with those in Lake Rudolf. Another mass of data of similar character is provided by the numerous studies by Dr. Regan and Miss Trewavas on the Cichlid fishes of the African lakes.

Perhaps the most interesting result, however, is that evidence is forthcoming on the speed at which evolution proceeds. By correlating the distribution of fish and other organisms with the results from geological research, it is possible to estimate the time during which certain lakes have been isolated. We hope that before long it will be possible to state definitely that in a given period, say 10,000 or 15,000 years, a fixed amount of evolution has taken place. The evidence up to date suggests that the speed of evolution in these tropical conditions is much more rapid than is generally presumed.

The lakes which have been studied so far in the way described above are the following: the Victoria Nyanza (by the Fishing Survey under leadership of Mr. M. Graham), Lakes Albert, Kioga, Edward, George, Rudolf, Baringo and some smaller lakes. In addition Lakes Bangweulu, Tanganyika and Nyasa have been or are being studied from extensive collections of fish in the British Museum. The last two present many unique problems of ecology by reason of the exceptionally

deep water and varied fauna, so they are next on the programme for intensive field studies.

Prof. E. W. MacBride congratulated Dr. Worthington, not only on the research, the results of which he had communicated to the Society, but on the manner in which he had employed the new facts which he had discovered. He had made it clear that he was not merely concerned with compiling a list of the fish inhabiting the lakes which he had described; his aim had been to discover at what period the species inhabiting one lake had diverged from those inhabiting another, and, therefore, to measure how long it had taken to accomplish a definite amount of evolution. This was a cardinal question of zoology, the only other similar attempt known to Prof. MacBride had been that of Prof. Woltereck, who gave an account of his results to the Linnean Society about fifteen months ago. Prof. Woltereck described the boulder clay which covered the south of Bavaria, and which had been produced by the great Alpine Glacier of the Glacial Age. As this receded and uncovered the clay, lakes were formed in depressions in the clay. The Daphniids inhabiting these lakes, when compared with those living in similar lakes outside the glacial area, were distinguishable not as different species, but merely as different races. The time that had elapsed since the formation of the lakes could not be less than 10,000 years.

Dr. E. Trewavas expressed her admiration of Dr. Worthington's methods, and her particular interest in the bearing of his work on the evolution of the many endemic species, especially of Cichlid fishes, that inhabit the African lakes.

Mr. J. R. Norman drew attention to the importance of such work as a basis for future fishery legislation. He stressed the necessity for a sound taxonomic foundation which involved the collection of adequate material for systematic work in addition to the ecological data.

Major S. S. Flower agreed fully with what had been said by the previous speakers, and expressed his appreciation of the very excellent research that Dr. Worthington was doing. Much of the work of observing, collecting and preserving these lake fishes had been done under adverse circumstances, which were overcome by expert knowledge, technical skill and personal bravery. Dr. Worthington took dangers and difficulties in his day's work, and had not even referred to them in his communication.

Dr. Worthington replied as follows :—

Miss Ricardo and I and the several members of my recent expedition are much honoured at the complimentary remarks of the previous speakers. We agree essentially with Mr. Norman and Miss Trewavas as to the importance of systematic studies

as the backbone of all other branches of biology, and are only too glad to be adding our small quota to the mass of work which is progressing all the time at South Kensington.

Prof. MacBride, by reference to Prof. Woltereck's results from southern Europe, has stressed the importance of estimating the speed of specific differentiation. The results from Africa on this subject depend, of course, on the establishment of a definite time scale in recent geological history, and the way in which the scale can be established is by correlating the African Pluvial and Interpluvial Periods with the Glacial and Interglacial Periods of Europe. African geologists and meteorologists are not yet all in agreement, but evidence is accumulating rapidly, and before many years are past we hope to have a time scale reasonably fixed. We agree that this will be the most important result from the academic standpoint, but we must express our view once again that no less important are the practical applications of the work, in pointing to ways in which the food resources of Africa can be exploited scientifically.

Plant collecting in Fiji*. By Dr. A. C. Smith (Associate Curator, N.Y. Botanical Garden).

The Fiji Islands first came to the attention of Europeans by the trip of Tasman in 1643, after which time they were observed by Cook (1773) and Bligh (1789). Sandalwood traders frequently called at the islands between 1800 and 1850, obtaining loads of *Santalum yasi* for the oriental market. Charts of the group were first made by d'Urville (1827) and the U.S. Exploring Expedition under Wilkes (1840). This latter expedition was accompanied by the botanists Brackenridge, Pickering and Rich, whose collections were subsequently studied by Asa Gray. MacGillivray and Milne, accompanying the ship *Herald*, collected in Fiji in 1856, and were followed by Berthold Seemann in 1860. Seemann's well-known 'Flora Vitiensis' summarized the botanical knowledge of Fiji of that period. More recent collectors in Fiji have been Horne, im Thurn, Gibbs, Parks and Gillespie, the latter two working under the auspices of the Bernice P. Bishop Museum of Honolulu. In continuation of their work, the speaker was privileged to spend nine months in the group in 1933 and 1934.

The total land area of Fiji is over 8,000 square miles, of which a large portion makes up the two islands Viti Levu and Vanua Levu. Next in importance are the islands of Kandavu,

* A fuller report may be found in the 'Journal of the New York Botanical Garden' for December 1934.

Taveuni, Koro, Ngau and Ovalau. Of the total of more than 200 islands, the majority are volcanic in origin, reaching elevations of more than 4,000 feet. Comparatively few islands, and these small ones, are of limestone origin.

The botanical affinities of the group are primarily with the larger islands to the west, especially, perhaps, with New Guinea. Our knowledge of all these groups is too incomplete to permit definite conclusions, but it may be supposed that the Fijian flora, in large part, is related to that of the New Hebrides, the Solomons and New Guinea. There are many genera and some species in common in Fiji, Samoa and Tonga. In general, the flora of the two latter groups is less diverse than that of Fiji, which in turn is less rich than that of groups farther west.

Beach vegetation is more or less similar throughout the Pacific, and in Fiji, as elsewhere, one finds the ubiquitous coconut, growing among such plants as *Pandanus tectorius*, *Calophyllum inophyllum*, *Barringtonia asiatica*, *Thespesia populnea*, *Hibiscus tiliaceus*, *Tournefortia argentea*, *Guettarda speciosa*, &c. The lowland tree, *Intsia bijuga*, is widely used by the Fijians in making houses, yanggona bowls, drums, tools, &c. *Piper methysticum* is everywhere cultivated, and is the basis of the national drink, yanggona (kava of the Polynesians). The principal food plants are the ndalo or taro (*Colocasia antiquorum*) and the breadfruit.

The direction of the trade winds in this part of the Pacific is from the south-east. In consequence of the rain which these winds carry, the southern and eastern slopes of the larger islands receive abundant moisture, while the northern and western slopes are subject to long dry periods. These latter areas are occupied by large extents of reed country, dominated by the grass *Miscanthus floridulus* and such shrubs as species of *Pandanus*, *Glochidion*, *Grewia*, *Weinmannia*, &c., and ferns of the genera *Pteridium* and *Gleichenia*. *Santalum yasi*, characteristic of this region, is now practically extinct.

Of more interest to the collector are the wet southern and eastern slopes, occupied by a rich and varied forest. At low and middle altitudes, the predominant plant of this forest is *Girroniera celtidifolia*. This is accompanied by many larger trees of the families Euphorbiaceae, Lauraceae, Anonaceae, Apocynaceae, Myrtaceae, and Rubiaceae, the latter family being the largest in Fiji in regard to number of species. Towards the summits of the mountains, the vegetation takes on a more or less dwarfed character, and as a rule different species are here represented. Among the attractive trees and shrubs of higher elevation are species of *Elaeocarpus*, *Astronidium*, *Decaspermum*, *Calycosia*, *Uragoga*, and *Cyrtandra*, while many orchids, notably the brilliant *Dendrobium Mohlia-*

num, cover the woody plants. Epiphytic species of *Peperomia* and *Lycopodium*, together with many mosses and hepatics, cloak the branches. Probably the most attractive liana in Fiji is the brilliant *Medinilla Waterhousei*, a Melastome with bright red bracts and delicate white flowers, found only at high elevations on Taveuni and Vanua Levu.

After collecting in the wet forest areas of Vanua Levu, Taveuni, Kandavu and Koro, the speaker visited the Lau Group, as the eastern islands of Fiji are known, visiting Moala, Fulanga, Kambara and Vanua Mbalavu. The volcanic portions of these islands support a comparatively poor flora, in which *Casuarina equisetifolia* and species of *Pandanus* are predominant. The herbaceous vegetation consists of grasses, sedges and a few ferns. The limestone islands, or portions of islands, in spite of the almost complete lack of soil, support dense forests, the trees *Pleiogynium Solanderi* and *Intsia bijuga* being very large. The predominant family, as elsewhere in Fiji, appears to be Rubiaceae. These limestone islands of Lau are perhaps the most attractive part of Fiji from a scenic point of view. The coast line is marked by a series of cliffs, all of which are undercut at the base; lagoons are numerous and shallow, and the dense green verdure on every hand gives to these islands the aspect traditionally ascribed to the South Seas.

Mr. H. N. Ridley commented on the resemblance of the Fiji flora to that of Malaya and the structure of the islands to that of Christmas Island. He called attention also to the great size attained by *Guettarda speciosa* and *Tournefortia argentea* as shown in the photographs, which is very much greater than is ever to be seen in Malaya.

Dr. A. B. Rendle said that he hoped Dr. Smith would give us the much desired Flora of these interesting islands. Referring to Miss Lilian Gibbs's work in Fiji, he recalled her statement that the movable cultivation by the natives was threatening the original vegetation in lower elevations, and asked Dr. Smith for information on this point. He regretted to hear that New Zealanders had been granted a concession to cut and export the Kauri-pine (*Agathis*), which had suffered much from injudicious felling in New Zealand.

In reply to Dr. Rendle, Dr. Smith stated that the northern slopes of the large islands are cultivated to a certain extent by sugar-cane growers, but, as this is naturally a reed country, no extensive clearing has been done. The native cultivation does not occupy large areas in the wet forest regions, which, in many localities such as the southern slope of Vanua Levu, remain practically virgin. Cutting the Fijian Kauri (*Agathis vitiensis*) is done on a small scale in Viti Levu.

7 NOVEMBER 1935

Dr. W. T. CALMAN, C.B., F.R.S., President, in the Chair

The Proceedings of the General Meeting held on Thursday, 24 October 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of William Watt Addison Phillips, Hampton Wildman Parker, William Albert Setchell, Atulananda Das, the Rev. Father Thomas Paris, John Walker Walton, Harold Downes, John Evan Adlard, Hirendra Kumar Nandi and James Harold Turner ; for the first time, in favour of Walter Lawry Waterhouse, Frederick Kirkwood Makins and General the Right Hon. Jan Christiaan Smuts, P.C.

The President reported the deaths of Prof. Henry Fairfield Osborn, Foreign Member, and Arthur Patterson, Associate.

The PRESIDENT stated that the Council had invited HIS MAJESTY THE KING OF THE BELGIANS to become an Honorary Member, and he read the following letter received from the Belgian Ambassador in London :—

AMBASSADE DE BELGIQUE,
103 Eaton Square,
London, S.W. 1.
October 28th, 1935.

SIR,

In reply to your letter of October 14th, I have the honour to inform you, by command of my Sovereign, that His Majesty the King of the Belgians has graciously consented to become an honorary member of the Linnean Society of London.

I have the honour to be, Sir,
Your obedient Servant,
E. DE CARTIER.

DR. W. T. CALMAN, C.B.,
President of the Linnean Society,
Burlington House,
Piccadilly,
London, W. 1.

The President said that His Majesty was well known to take a keen interest in Natural History. When Crown Prince he made a voyage to the Dutch East Indies in 1928–29, one result of which was the obtaining of a very important collection of specimens for the Royal Museum of Natural History in Brussels. He has also taken an active interest in the preservation of the fauna of Africa by the establishment of Nature Reserves. The great Parc National Albert in the Belgian Congo, the area of which has recently been greatly extended, owes much to his Majesty's patronage and influence and constitutes one of the most important experiments ever made in the conservation of wild nature.

His Majesty was then formally elected by acclamation, all present rising in their places.

Along the Linyanti River. By Miss EDITH L. STEPHENS.

THE Linyanti (Chobe) enters the Zambesi about forty miles west of the Victoria Falls, and forms part of the northern boundary of the Bechuanaland Protectorate. With its numerous backwaters, swampy stretches, and isolated pools this river is rich in aquatic life of every kind. The variety of bird life in its neighbourhood is also striking, over a hundred species being noted. Of the aquatic vegetation the Algae and Charophyta were specially noticeable for variety and interest. Among the flowering plants were noted: *Aldrovanda vesiculosa*, *Ceratophyllum demersum*, *Elatine* sp., *Jussieua fluitans*, *Lagarosiphon* spp., *Naias pectinata*, *Nymphaea caerulea*, *Ottelia muricata*, *Potamogeton* spp., *Trapa bispinosa*, *Utricularia stellaris*, *U. reflexa*, *Vallisneria aethiopica*. The occurrence of *Aldrovanda* is of interest, as this genus is not recorded for Africa. It had also been found by the lecturer in Portuguese East Africa.

The waters of sub-tropical southern Africa offer a rich and almost unworked field for investigation. Particularly noteworthy are the interesting possibilities of the numerous, ecologically very varied, and easily accessible lakes and lakelets which stud the coastal belt of Portuguese East Africa from the Limpopo to Inhambane.

Dr. A. B. RENDLE, commenting on the typical submerged Utricularias shown by Miss Stephens, asked whether she had found any of the small terrestrial species such as he had collected when botanizing with Prof. F. E. Lloyd in the water-soaked vegetation on Livingstone Island at the edge of the Victoria Falls, and by the Chibopopo River near Zimbabwe.

Prof. F. E. Weiss asked whether the pied kingfisher mentioned by Miss Stephens was the same species as the one he had seen in Egypt, and which showed the same habit of hovering over the water while in search of its prey.

Miss Stephens replied that it probably was the same species, as the one she had mentioned in her lecture extended from Central Africa to the Cape.

Dr. J. Burtt Davy asked whether the Mahogany Bean Tree, *Afzelia quanzensis* Welw., was plentiful in the vicinity of the Linyanti River, and whether she knew the name of the very flat-crowned *Acacia* shown in one of the photographs. Miss Stephens replied that there were several specimens of the *Afzelia*, but that it was not abundant, and that she had not yet identified the *Acacia*.

Mr. C. G. Rogers, Mr. S. Garside and the President also spoke.

An appeal for assistance in the study of Lepidopterous Parasites. By Mr. D. S. Wilkinson, F.R.E.S. (Visitor).

On the suggestion and invitation of Dr. Kemp I am here to-night to indulge in some propaganda on behalf of my work. My object to-night is to acquaint Fellows of this Society with an aspect of systematic entomology that I feel sure has escaped their attention, and to solicit any assistance that they can give me.

I am engaged upon a monograph of the Braconid genus *Apanteles* Förster, a group restricted from Latreille's genus *Microgaster*. Species in these two genera are, I believe, entirely restricted to Lepidopterous hosts, as internal parasites of the larvae, and are immediately recognizable to the uninitiated by the form and composition of the cocoons which are constructed by the parasitic larvae immediately after boring their way out from the host caterpillar. These cocoons are papyraceous and covered with white or pale lemon-coloured silken strands. They are usually solitary or grouped together loosely, but occasionally occur heaped together in a flocculent white mass of silk, or in a hard compact mass of silk; and very occasionally they are heaped one row upon another for all the world like a pile of drain-pipes alongside a road under repair. I have brought with me to-night a box with typical examples of these cocoons, although I am certain that any Lepidopterist who is here will know them well.

Since Linnaean times there have been but few men working on the Parasitic Hymenoptera compared with the numbers that have been attracted towards the study of such groups as the Coleoptera and Lepidoptera; and if we ignore those who worked chiefly on the true Ichneumons and on the

Chalcididae, and confine our attention to those whose chief study was the Braconidae, or Supplementary Ichneumons, we find that there are a mere dozen or so whose work is of any significance. And if we still further restrict our field to those to whose work I must pay particular regard, we find eleven men, namely, the Englishman, Curtis, the Irishman, Haliday, and two Germans, Bouché and Nees von Esenbeck, all writing about 1832; the Belgian, Wesmael, of a few years later; three more Germans, Ratzeburg, Ruthe, and Reinhard, from about 1840 to 1880; the Englishman, the Rev. T. A. Marshall (at least I believe he was an Englishman), who was writing about 1885 to 1888; the Swede, Thomson, of two or three years later, a man who incidentally wrote very extensively on the Ichneumonidae also; and finally, Lyle, who has but lately died. These eleven men described numerous palaearctic species in the group which we are discussing: in my files I have some 400 names, but among them are included quite a fair number of *nomina nuda* of other authors, and also some Russian and Japanese species with which at the moment I am not concerned.

From a critical study, however, of the writings of these eleven men a curious fact emerges, namely, that none of them saw each others' material, either through lack of opportunity, or, as is more likely, through lack of energy. The result is that their work is not to be trusted—I have proved that in practice already—and the revisions that two or three of them wrote are also untrustworthy, in fact definitely misleading. Their collections, however, have luckily been preserved. The Curtis collection, in which are many of the Haliday types, is admittedly rather remote, being in Australia: but the Haliday collection proper is in Dublin—unfortunately in rather indifferent condition. Bouché's types, as also Reinhard's, are in Berlin, in remarkably good order—I have seen them. Wesmael's collection is in Brussels and has been carefully preserved. Ratzeburg's material, in rather a muddle, is housed in Eberswalde, some 20 miles north-east of Berlin, but Prof. Wolff was so good as to permit me to bring the *Apanteles* types back with me to London, and they are now in my room in the Museum. The Nees collection, or rather that part of it in which I am interested, was destroyed during, or shortly after, the War by a custodian ignorant of its value: but his species will, I believe, be recognizable from material in the Klug collection to which Nees continually refers, and this is now also in Berlin. Thomson's material I have not yet seen: it is in Lund, in Sweden. Finally, the Marshall and Lyle collections are in the British Museum. But, and here is the rub, of what value to me are these carefully conserved collections of type material if I have

no material of my own with which to make comparisons? I want not only to make comparisons, but to have long series, so that I can made numerous preparations (there being many excellent characters in the genitalia) and still have material to deposit in the British Museum as a lasting record. But I have such a pathetically small amount of material. Not once, but many times, have I had to lay aside a type because I had nothing with which to compare it. This, then, is my appeal to those in this Society who are interested in Lepidoptera. Keep for me all the parasites that you breed, together with the names of their hosts: do not destroy them, as do the majority of Lepidopterists. I assure you the material is urgently required, not only by me in the Braconidae, but by all other workers in the Parasitic groups.

Finally, in expressing my thanks for the opportunity of making this appeal, I would remark that I am shortly publishing, in the 'Entomologist', a list of Lepidopterous hosts from which I am particularly desirous of obtaining *Apanteles* parasites.

Dr. Stanley Kemp hoped that those who bred Lepidoptera would remember this appeal. If, instead of slaughtering unwelcome parasites, they would preserve them and send them to Mr. Wilkinson, they would be rendering a real service to entomological science.

The Seasons in a Tropical Rain-forest.—Parts 1 & 2.

By Dr. J. R. Baker. [Abstract.]

The Oxford University Expedition to the New Hebrides, 1933–4, made an investigation, lasting twelve months, of seasonal biological phenomena in a climate which varies little during the year. The work was financed partly by the Percy Sladen Trustees, the Royal Society, and New College, and was done under the auspices of the Oxford University Exploration Club. In the two papers submitted on this occasion the meteorological and botanical findings were discussed.

A general comparison of the climate of Hog Harbour, Espiritu Santo, New Hebrides (15° 15′ S.) with that of other parts of the world was instituted, and it was stressed that although tropical regions often have very small temperature changes during the year, there is usually a marked dry season. In the northern New Hebrides there is no dry season, but certain months (June to October) are less wet as well as slightly cooler than the rest. The hottest month is only 2·1° C. (3·8° F.) hotter than the coolest. The dryest month has nearly twice as much rainfall as the wettest month

in most of England. Especial attention was paid to the measurement of climate in the situation in which the plants and animals live by the establishment of a meteorological station in the rain-forest itself, in addition to a station in the open. Regular readings were made with the katathermometer and Livingston atmometer, in addition to all the ordinary instruments. Although there is no regular seasonal change in the daily amount of sunshine, yet the amount of ultra-violet light was found to be much less when the sun is to the north.

Observations were made on the flowering and fruiting of nine species of wild plants. Two of them, namely, the herb *Geophila herbacea* and the shrub *Piper methysticum*, and probably also the tree *Ficus copiosa*, reproduce throughout the year. *Corymborchis veratrifolia*, *Eugenia* sp., *Barringtonia samoensis* and *Psychotria* sp. have a long reproductive period from about September to January and a short one about May and June. *Garuga floribunda* and *Castanospermum australe* have a single reproductive period in the year. *G. floribunda* is probably the only tree in the northern New Hebrides with complete leaf-fall at about the same time each year. Certain wild trees are so regular in their flowering and fruiting periods that the natives depend upon them for the time of planting of their annual crops.

The results of the study of the seasonal phenomena in animals will be submitted in later papers.

After congratulating Dr. Baker on his valuable paper, Mr. A. W. Exell pointed out the importance of studying the behaviour of individuals as regards season of flowering and fruiting. Sometimes in the tropical rain-forest individual members of a species show remarkable differences in this respect.

Mr. I. H. Burkill called attention to the existence in plants of several cardinal points which determine flowering and fruiting, and to the circumstance that they are widely different in different species. He added that under these circumstances co-ordination between the work of stations adopted for observation would lead more quickly to results than the observation of certain plants in one place and other plants in another.

Dr. J. Burtt Davy said that both the individuality of the tree and the environment in which it grows affect the time of flowering, and the time and length of duration of the deciduous period. This is definitely shown by tropical African species on the Great Central Plateau, south of the equator. When crossing the central portion of this plateau in 1929 he was able to observe and collect material of trees,

of the same species, some of which still retained their old leaves and had not developed their flower-buds, while others within sight of the same tree had lost their old leaves, and were unfolding their new leaves, in brilliant colours, and commencing to flower. In certain areas all the trees, without exception as far as one could see, were leafless, while a few miles further on practically all were still in leaf *.

In this region there appears to be considerable variation in the length of the deciduous period, i.e. from two or three weeks down to two or three days only.

The conditions are, of course, entirely different from those in the New Hebrides, the rainfall approximating to only 35 inches, and even less, with a rainless period of about seven months, in the winter season, accompanied by distinctly cool nights. The altitude is approximately 3,500 to 4,000 feet.

In answer to Mr. Burkill, Dr. Baker heartily welcomed the proposal to select a few suitable species of tropical plants and try to get people to observe them over a wide area; and he expressed his readiness to co-operate in any such scheme.

The following paper was read in title :—

'The limnology of the Long Pool, Butterby Marsh, Durham : an account of the oxygen-content, and composition of the water, and the periodicity and distribution of the phyto- and zooplankton.' By Dr. B. Millard Griffiths, F.L.S.

21 November 1935

Dr. W. T. Calman, C.B., F.R.S., President, in the Chair

The Proceedings of the General Meeting held on Thursday, 7 November 1935, having been circulated, were taken as read and confirmed.

* A striking feature of this region, and one which seems to have a bearing on the question raised by Dr. Baker, is the annual appearance of a 'pre-rain flora'; this term refers to the annual flowering of certain species near the end of the dry period, and *before* the commencement of the rainy season, i.e. before *any* rain has fallen. Many of the species which show this characteristic develop flowers on annual epigaeous growth from a perennial hypogaeous stem; these represent several distinct families, e.g. Malvaceae, Papilionaceae, Cochlospermaceae. In some cases, however, the pre-rain flora species are trees, such as species of *Stereospermum*, *Ochna* and *Erythrina*. The flowering of the plants referred to is not associated with any obvious differences in telluric moisture, for all of them occur on the dry, and often shallow, soils of the savannah-woodland, and are surrounded by species which do not show special pre-rain flora tendencies.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Wilfred Ernest Watson Baker, Cyril Francis Hill and Francis Colville Minns.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Walter Lawry Waterhouse, Frederick Kirkwood Makins and General the Right Hon. Jan Christiaan Smuts, P.C. ; for the first time, in favour of Tiruvilandur Srinivasa Raghavan.

The President reported the death of John Cameron, Fellow of the Society.

The occurrence of the Chimpanzee in Tanganyika Territory.
By Capt. Guy Dollman.

Captain Guy Dollman exhibited the skull of a chimpanzee from the Mahare Mountains, Kasogi, Kigoma District, Western Province, Tanganyika Territory, which had been presented to the British Museum (Natural History) along with several other specimens by Mr. B. W. Savory, of the Political Service, thanks to the courtesy of His Excellency the Governor of Tanganyika Territory.

The skull was brought to Mr. Savory by a native of Kasogi, and it was evident that the chimpanzee was by no means rare on the eastern shores of Lake Tanganyika. Additional evidence of the existence of this species, in the form of foot-prints and sleeping-platforms, was observed by Mr. Savory in the Kigoma District, about a dozen sleeping-platforms being discovered. This is one of the most south-easterly localities from which the chimpanzee has ever been recorded, situated as it is on the eastern shores of the lake, south of Kigoma. For the time being the specimen has been referred to the Eastern Chimpanzee, *Anthropopithecus troglodytes schweinfurthi*, a race inhabiting the southern Bahr-el-Ghazal, Uganda and the Belgian Congo. It was pointed out that chimpanzees have been recorded from the west side of the lake as far south as the Marungu District, whence a special race has been described as *Anthropopithecus troglodytes marungensis*. The material available for examination does not, however, appear to support the existence of such a distinction, and it seemed preferable for the time being to regard all these southern chimpanzees as representing the eastern race.

Captain Dollman drew attention to the fact that the chimpanzee enjoyed a much larger distribution than its cousin the gorilla. The latter species is found over a considerable area of West Africa, extending from the Cameroon borders of Nigeria through a great portion of French Equatorial Africa, and occurring again in the Lake Kivu district and perhaps the Ituri Forest district of the Belgian Congo. The chimpanzee, on the other hand, is widely spread across Africa from Sierra Leone and the Gambia on the west to the Bhar-el-Ghazal, Uganda and Tanganyika Territory in the east. It is possible, when more material comes to hand, that the chimpanzees from the east of Lake Tanganyika will be found to represent a race distinct from that found on the western shores of the lake, but at the moment there would appear to be no justification for such a subdivision.

Mr. Savory, in his report, had drawn attention to the fact that the collecting of chimpanzees in the Western Province of Tanganyika Territory was an extremely difficult proposition, as not only were the natives very superstitious concerning this species, believing these apes to be reincarnations of deceased human beings, but also there was a widespread idea that if a man fired a gun at one of these animals the barrel would be sure to burst.

In conclusion, Captain Dollman stated that Mr. Savory was to be congratulated on establishing the fact that the chimpanzee occurred as far south as the Mahare Mountains on the eastern shores of Lake Tanganyika. Rumours of the chimpanzee occurring in the northern portion of Tanganyika Territory had been current for some time, but this was the first reliable information proving the existence of this ape as far south as Kasogi.

Remarks on the exhibit were contributed by Mr. W. S. Rowntree, Prof. G. D. Hale Carpenter, Mr. M. A. C. Hinton and the President.

Studies in Linnaean synonymy. 1. Caspar Bauhin's 'Pinax' and Burser's herbarium. By Mr. S. Savage.

In 1726, at the age of nineteen, Linnaeus, with the reluctant consent of his parents—who had hoped that he would become a priest—began his first studies in scientific botany and medicine at Växjo under Dr. Johan Rothman, who had undertaken to give him private tuition. Some record of those studies, between September 1726 and May 1727, still survives in a MS. in the Linnaean Collections, and one page shows that Vaillant's views on the structure of the flower were made known to Linnaeus by Dr. Rothman. This

fact has been overlooked by Linnaeus's biographers, for it is usually stated that in 1729—more than two years later—it was the reading of a review of Vaillant's 'Discours sur la structure des fleurs' of 1718 which gave Linnaeus his inspiration to found the Sexual System. Nevertheless, in the surviving MSS. of Linnaeus's early botanical work until the year 1730 Tournefort's system was used; and from the year 1731 onwards Linnaeus always used the artificial system invented by himself, although he had drawn up a fragmentary Natural System. Dr. Johan Stensson Rothman (1684–1763) was forty-two years of age in 1726, and deserves to be specially remembered amongst Linnaeus's teachers as the medical man who passed on to him these then recent botanical discoveries.

When in 1735—exactly 200 years ago—Linnaeus published in his 'Systema Naturae' a rearrangement of all known genera of plants he had not accomplished this without considerable disturbance to accepted botanical nomenclature. Automatically, his System,—based upon the number of stamens and pistils,—demanded numerous regroupings of genera and species involving the transposition of many accepted generic names; further, many accepted generic names were rejected as unsuitable. By these innovations he brought about an almost unparalleled discontinuity in botanical nomenclature.

Eighteen years went by before Linnaeus was able to make his next great contribution to botanical progress by giving an account of all known species arranged according to his System, each species having a binary name. Without any doubt his greatest achievement was his 'Species Plantarum'. Here is what he himself, in his characteristic way, said of it in the autobiography written towards the end of his life:—

'At this time [1751] *Linnæus* commenced a greater work, namely, the *Species Plantarum*, (after having finished, and laid the foundation with, the *Genera*), in order to bring the science down to the present time,—a work which is now the greatest in botany; but *Linnæus* was at present the only person who had sufficient materials for it, having got so large a collection of plants, and seen so many gardens and collections,—in short, having seen so many more plants than any body else. By such a book every one could see what had already been discovered; what was new, when it occurred; and how it was to be named, which otherwise would not have been possible' *.

Published at a period when the discovery of new species was developing rapidly in all parts of the world, the 'Species

* Pulteney, A general view of the writings of Linnaeus . . . second edition . . . by William George Maton . . . , pp. 544–5 (1805).

Plantarum ' of 1753 and the second edition of 1762–3 were just what was wanted by botanists. The System enabled any plant to be filed as it were in the correct pigeon-hole. The time had not yet come for founding a Natural System, and although Linnaeus's System is dead today, his work on the genera and species of plants still lives on.

My present object is to endeavour to trace, by the help of certain Linnaean MSS., exactly how Linnaeus dealt with the so-called ' species ' recorded in Caspar Bauhin's ' Pinax '. Although constituting only a fraction of the number of species in the first edition of the ' Species Plantarum ', nevertheless they are particularly interesting as constituting the body of plants dealt with by western botanists up to about the year 1623, the year when the ' Pinax ' was first published.

Caspar Bauhin is stated to have taken forty years to compile his ' Pinax '. (He died in 1624, the year after its publication.) It contains about 6000 diagnostic plant names (I use this term to distinguish the older names from the Linnaean binary names), under which are arranged what were in his opinion the synonyms of all previous western botanists. The systematic arrangement, as would be expected, leaves much to be desired. Beginning with the Grasses (among which he included *Fucus Tendo*), he goes on with a series of genera now included in the Liliaceae, Iridaceae and Orchidaceae ; continuing with many dicotyledonous genera with some intermixture of genera of monocotyledons until he reaches the Ferns, Mosses, Lichens, Algae, Corals, Sponges and Fungi ; after which comes a series of genera such as *Carduus*, *Cirsium*, *Centaurea* and *Cytisus* ; trees and shrubs concluding the work. The point to be brought out here is that in spite of a faulty systematic arrangement Bauhin knew his plants extremely well. Undoubtedly it was for that reason his ' Pinax ' proved so valuable a book to his successors *.

Linnaeus became acquainted with Bauhin's ' Pinax ' at least from the time of his tuition under Dr. Rothman in 1726, for it stands recorded in the list of botanical works recommended to him. In 1730, whilst still a student at Uppsala University, he received a copy of the second edition of the ' Pinax ' as payment for giving private lessons in

* Linnaeus's estimate of Bauhin's place in botanical history can be gauged from the following MS. entry in his own copy of ' Philosophia botanica ' :—

' PRINCIPES Botanicorum

1580 Cæsalpinus 1600
1600 C. Bauhinus 1625
1670 Morison 1680
1680 Hermannus 1690
1690 Tournefort 1706
1715 Vaillant 1720
1720 Sherard 1730
1730 Dillenius 1745
1745 Linnæus.'

botany to a fellow medical student, Carl G. Warmholtz. This copy, which bears a Latin inscription to Linnaeus by Warmholtz dated 1730, is still in Linnaeus's Library, and was without doubt in constant use by him from that date. It contains about 3000 specific determinations, made by Linnaeus in the form of marginal annotations. Quite early he wrote some of his generic names against Bauhin's diagnostic names, and during his preparation for the 'Species Plantarum' added the specific names.

At a first glance it may seem a mere waste of time to try and discover whether or not in any instance the Linnaean synonym did denote exactly the same plant that had been known to Bauhin. It will be said: 'Of course Linnaeus made sure that the plant he was describing in the "Species Plantarum" was the same as the one described in Bauhin's "Pinax"; otherwise he would have failed to have convinced his contemporaries'. Nevertheless, from a purely historical point of view it must always be admitted to be of great importance that individual species should be capable of being traced back as far as possible,—in other words, that plants should be capable of being followed back in the reverse order of the historic sequence of their identification in the past. When, however, the problem is tested it is found to be not so simple. It is at once evident that every increase in the knowledge of plants makes it more difficult to understand exactly what an older author meant concerning a particular plant, unless we have the actual specimen he was writing about. Even then, it must be difficult in some cases to be sure that the older author really did know that particular species of plant. On broad morphological grounds he may have been confusing it with quite another species as understood today. It is certain that although the synonyms cited by Bauhin cannot be accepted without careful verification elsewhere, his actual plant specimens may be in some good measure treated as concrete evidence.

A careful examination of these determinations written in the margins of his copy of the 'Pinax' shows that they are Linnaeus's record of his wide knowledge of plant synonymy. As some specific names are later in date than the first edition of the 'Species Plantarum' it is certain that Linnaeus—to some extent at least—kept this record up to date during his lifetime. It also includes a few obsolete generic names (belonging to his early period), for example *Galanga* for *Kaempferia*, as well as some MS. specific names, as for example *Festuca natans* (for *Festuca fluitans*), *Anemone malvaica* and *Galium luteum*. Without any doubt this copy of the 'Pinax' was in constant use during his stay in Holland, of which period he wrote 'One may judge of the amount of

work that I accomplished in Holland: where I wrote more, discovered more, and reformed more in botany than anyone had done before in his whole lifetime'.

Could Clifford's library be reassembled today some of its volumes might be found to bear traces of Linnaeus's researches in synonymy. The older works in Linnaeus's Library give but little indication of having been thoroughly investigated,—one exception being his copy of Cæsalpinus, 'De plantis . . . ', 1583, which has Linnaeus's generic names written in the margins throughout. I think, however, that Linnaeus always placed plants before books, using the works of other botanists merely as records, his MS. determinations indicating that he knew the plants there recorded.

Another Linnaean MS. which has an important bearing on the 'Pinax' species is one of 35 pages containing Linnaeus's determinations of the majority of the plants in Burser's herbarium. Joachim Burser, one of Caspar Bauhin's best pupils, was born in Kamenz, Saxony, in 1583 and died in 1639. He had travelled widely in Europe, making a considerable collection of plants, some of which he was the first to make known to Bauhin. In 1625 he became professor of medicine and botany at Sorö in Denmark. About 1664 his herbarium, which at his death had been acquired by a Danish bibliophile, Jörgen Seefeldt, became part of the booty in a war between Sweden and Denmark. Bound in 25 volumes it was presented by the Swedish State Secretary Coijet to Uppsala University Library. It still remains in Uppsala, except for two volumes destroyed by fire before Linnaeus's time.

As early as 1728 Linnaeus (then 21 years of age), together with his fellow-student Artedi, made constant use of Burser's herbarium. Arranged in the same sequence as Bauhin's 'Pinax', later on these plant-specimens must have been of much help to Linnaeus in his early attempts to fix the genera according to his own System; but with the exception of an occasional reference in some of his earlier MSS., the record of those early studies appears to be wanting. It must not be overlooked that from April 1735 to June 1738 Linnaeus was in Holland, and even after his return to Sweden it was not until October 1741 that he went back to Uppsala, as a professor.

This MS. of Linnaeus's determinations in Burser's herbarium is unbound (32·5×20·5 cm.), and consists of an outer wrapper on the first page of which Linnaeus has noted the number of volumes in the herbarium. The second folio (22×13 cm.) contains a tabular list comparing the volume numbers of the herbarium with the Book, Section, and number of pages in Bauhin's 'Pinax'; on the verso are rough notes on *Salix*, etc., also a long sentence which Dr. A. H. Uggla has suggested to me maybe a draft for one of Linnaeus's lecture programmes.

The actual lists of determinations occupy pages 3–35, and are very closely written, so that (allowing for blank spaces) 27½ pages meant 87 full pages of foolscap paper in the transcript I found it necessary to make before this material could be used. The arrangement of the list is roughly tabular, *first* the plant-number in the Burser herbarium, *second* the Linnaean determination, *third* the ' Pinax ' or other name taken from Burser's inscription (these are greatly shortened by Linnaeus, whose impatience with these old diagnostic names is clearly visible at places in the MS.), and *fourth*, often in abbreviated form the localities (or some of them) as given by Burser. (Some of these last may be the sources of certain obscure localities cited in the ' Species Plantarum '.)

As in Linnaeus's determinations in his copy of the ' Pinax ', here also are MS. specific names, as, for example, *Vinca procumbens* and *Vinca erecta* (for *Vinca minor* and *Vinca major*), *Lavandula serrata* (for *Lavandula dentata*), *Echinophora maritimum* (for *Echinophora spinosa*), both derived from the Bauhin name *Crithmum maritimum spinosum*.

I have noticed three instances of MS. specific names common to both the ' Pinax ' and the Burser determinations :— *Carduus eriocephalus* (for *Carduus eriophorus*), *Echium Lycopsis* and *Antirrhinum americanum*. Another feature common to both MSS. is the use in a few instances of a generic name which Linnaeus never published in connection with a particular species, for example, *Solidago Doria* (for *Senecio Doria*), *Solidago alpina* (for *Cineraria alpina*).

A study of these two Linnaean MSS. shows clearly that each is a compilation previous in date to the first edition of the ' Species Plantarum ', but containing some subsequent additions. That both were much used by Linnaeus in writing his ' Species Plantarum ' is certain, for in them he would have at a glance the essence of many years of investigation.

From 1746 to 1748 Linnaeus devoted much time to an attempt to write the ' Species Plantarum ', and a portion of the MS. of this draft was re-assembled by Dr. J. M. Hulth in 1912 when he carried out an examination of the Linnaean MSS. This draft differs from the published ' Species Plantarum ' both as regards general arrangement and in the greater number of synonyms cited for many species *. Very few binomials are given. (Linnaeus's first use in print of binomials was in 1749 with the dissertation ' Pan suecicus '.) There are a good many marginal notes referring to Burser's herbarium, such as *vide Burser*, *N.B. Burserus*, *vide de hoc Burseri herbarium*. Writing on 6 Oct. 1749 to his friend Dr. Bäck, Linnaeus says ' It is a year since I had time to

* In the preface to Sp. Pl. ed. 1, Linnaeus states that for most European species he has contented himself with citing the Bauhin synonym and a reference to the best illustration.

look at it ' [i.e. Species plantarum]. It seems not improbable that one of the things he did on giving up work on this early draft was the determination of nearly the whole of Burser's herbarium. His own knowledge of the older synonymy, carefully gathered during his years abroad from herbaria and books, must have received in part a considerable confirmation from these later studies in Burser's herbarium.

Bearing these points in mind it seemed worth while to carry out a somewhat detailed investigation with the object of testing how far Linnaeus did describe the same species as Caspar Bauhin and of discovering how far Burser's plants agreed with those of Bauhin, whose herbarium is still preserved at the University of Bâle. Linnaeus never went to Switzerland. Haller writing to Linnaeus in 1738 mentions Bauhin's herbarium ; and Linnaeus in a letter to Haller dated 7 Jan. 1746, writes ' The Herbarium of Burser would doubtless be of great use to you, as he walked over so many of the German states, and has annexed the place of growth to every specimen '. Haller never consulted Burser's herbarium.

In 1818 A. P. de Candolle carefully examined a large number of Bauhin's plants and recorded his determinations in his copy of the ' Pinax '. These were published by C. de Candolle in 1904 in the ' Bulletin de l'Herbier Boissier '. From 1821 to 1845, C. F. Hagenbach, a medical man at Bâle, published in his ' Flora Basiliensis ' his determinations of that part of Bauhin's herbarium required for his Flora. (Here I must remark that the reprint of those determinations by Saint-Lager in his ' Histoire des Herbiers ', 1885, is very inaccurate.) Here then are two sets of determinations of a considerable portion of Bauhin's herbarium, carried out independently ; in one instance by a celebrated systematic botanist.

There remains to consider what has been done in connection with Burser's herbarium. In 1745, about three years after his return to Uppsala, Linnaeus published the dissertation ' Plantae Martino-Burserianae ', which gave a list, with synonyms, of 240 plants selected from Burser's herbarium. This has no direct bearing on the present enquiry, as at that date Linnaeus had not adopted binomials. Burser's herbarium had been studied before Linnaeus's time, both by the Rudbecks for their ' Campus Elysius ' 1701–2, and by Per Martin, the father of the *respondens* of the Linnaean thesis of 1745. The late Professor H. O. Juel of Uppsala published in the Nova Acta of the Royal Society of Sciences of Uppsala in 1923 a long and very thorough paper ' Studien in Burser's Hortus Siccus ', which dealt with about 600 specimens, incidentally giving all citations in literature. This paper has been a great help in the present enquiry, both in giving details omitted in the Linnaean MS. and in supplying

Linnaeus's determinations of all the plants in Vol. 25 of the herbarium. The Linnaean MS. stops with Vol. 22, and Linnaeus wrote his determinations on the actual sheets of Vol. 25. Finally, it must not be overlooked that occasionally in the 'Species Plantarum' itself there are direct references to Burser's herbarium.

The comparison of these different groups of determinations was made in my own copy of the second edition of the 'Pinax', which I had rebound and interleaved. After completing my transcript from the MS. of the Burser herbarium determinations, that together with the other groups were entered up on the interleaves. The resulting compilation naturally shows a certain amount of incompleteness, due to limitation of time in the case of de Candolle (who had hoped to return to Bâle to carry out further determinations for use in his *Prodromus*); of distribution in the case of Hagenbach (who determined only the Swiss plants required for his Flora); and for various reasons Linnaeus ignored 1930 Bauhin 'species',—as merely horticultural (some of the Tulips, &c.); certain exotics (for which he no doubt had better sources of information); the sections on fruits, juices, gums, etc.; and some plants about which Bauhin himself was uncertain.

The results of this comparison can best be shown in tabular form. In the following statements it should be kept in mind that the main comparison is between the determinations in Bauhin's 'Pinax' or herbarium and those in Burser's herbarium. Linnaeus never saw Bauhin's plants, and de Candolle and Hagenbach did not examine the Burser herbarium.

STATEMENT OF TOTALS.

Bauhin's 'Pinax' or Herbarium.

There are 5718 'species' in the '*Pinax*'*, of which
1930 are not determined,
104 are determined by *generic* names,
357 are here excluded as disagreeing,
2696 are *specifically* determined by LINNAEUS in his copy of C.B.P.
1027 are *specifically* determined by DE CANDOLLE. [*Herbarium.*]
754 are *specifically* determined by HAGENBACH. [*Herbarium.*]

Burser's Herbarium.

1822 specimens have been determined *specifically* by LINNAEUS (plus about 470 not in C.B.P.),
267 are here excluded as disagreeing.

* This is the number of Bauhin's diagnostic names which are preceded by Roman numerals. The double-'species' which are a well-known feature in the 'Pinax' are here counted as two species only where the determinations are in agreement.

TABLE OF AGREEING DETERMINATIONS.

Bauhin.			Burser.	
Linn.	*DC.*	*Hag.*	*Linn.*	*No. of agreements.*
407	407	407	407	407
276	276	—	276	276
104	104	104	—	—
88	—	88	88	88
777	—	—	777	777
52	—	52	—	—
—	—	7	7	7
—	18	18	18	18
—	34	34	—	—
—	30	—	30	30
74	74	—	—	—
918	—	—	—	—
—	84	—	—	—
—	—	44	—	—
—	—	—	219	—
2696	1027	754	1822	1603

It will be seen that 1603 (or 88 per cent) out of 1822 determinations of Burser's specimens made specifically by Linnaeus agree either with the Bauhin plants or with Linnaeus's determinations from synonymy or other herbaria.

Conclusions.

1. Linnaeus's determinations in Burser's herbarium probably had a considerable influence on the final form of the synonymy of the European species in the 'Species Plantarum'. In the preface of his last botanical work, the second 'Mantissa', 1771, he reasserted his acceptance of the Bauhin synonyms for European plants, adding that those which were still somewhat obscure could be settled only by the Swiss botanists.

2. Linnaeus's conception of some of the European species may have been much influenced by Burser's plants.

3. Linnaeus's own herbarium at the time of the publication of the 'Species Plantarum', 1753, did not contain all the plants he had there described. From three enumerations we know with some certainty what he had in his herbarium by the years 1753, 1755 and 1767. It is certain therefore that the Burser Herbarium contains many Linnaean type-specimens. To take an example, the genus *Valeriana*, as recorded in Dr. B. Daydon Jackson's 'Index to the Linnaean Herbarium' *, when considered in connection with Linnaeus's

* *V. Cornucopiae* is there marked as included in the 1753 enumeration, but it was not so marked by Linnaeus.

determinations in Burser's herbarium, shows that about one-third of the type-specimens may be in Burser's herbarium :—

VALERIANA.		
Calcitrapa.	1	
celtica.	3	B ×
chinensis.	1	
Cornucopiae.		B ×
dioica.	1	B
echinata.	3	
elongata.	3	
Locusta var.		B ×
Locusta varr. mixta.		
montana.	3	B ×
officinalis.	1	B
Phu.	1	B
pyrenaica.	1	

VALERIANA.		
rubra.	1	B
saxatilis.		B ×
scandens [Loefl.].		
sibirica.	1	
supina.	3	
tripteris.	3	B ×
tuberosa.		B ×

1 = A.D. 1753.
3 = A.D. 1767.
B = *agreeing* determination in *Burser's Herb.*

N.B. Those marked × are in all probability Linnaean type-specimens in Burser's Herbarium. (*V. saxatilis* is recorded as a Burser specimen in Sp. Pl. ed. 1.)

The PRESIDENT, in proposing that the thanks of the Society be given to Mr. Savage for his communication, expressed the satisfaction felt by the Fellows that Mr. Savage's unrivalled knowledge of the Linnaean collections was being used to make the collections more useful to future workers.

Dr. A. H. UGGLA (Secretary of the Swedish Linnean Society) wished to emphasize the interest of Mr. Savage's statement, that already during his school-days, through the lectures given to him by Dr. Rothman (in 1726), Linnaeus got acquainted with Vaillant's ideas on sexuality in plants as a basis for their arrangement. It was formerly stated, and on Linnaeus's own authority, that it was only in 1729 that, through a German newspaper, he met with those ideas. But it must be kept in mind that Linnaeus's statements in his autobiographies are not always reliable, as in later years he got more and more disposed to set off the contrast between his early achievements and the difficulties met with. The history of the development of his Sexual System gets more intelligible now that we know that those ideas of his had been growing in his mind for several years.

Mr. J. RAMSBOTTOM said that Mr. Savage's paper was really in two parts. Dr. Uggla had stressed the interest of the discovery of the fact that Linnaeus had an earlier knowledge of Vaillant's classification than he had himself admitted—a point of psychological as well as historical importance. The manuscript indicated that Mr. Savage must have a sharp eye in addition to a considerable knowledge of his subject.

The second part, however, was the more important, as it showed very clearly the significance of Burser's herbarium in the consideration of Linnaeus's types. When dealing with the Linnaean Herbarium some botanists seemed to have lost their sense of proportion. Great as Linnaeus's opinion of his own work was—with abundant reason—it is foolish to imagine that he could ever have anticipated the importance that future botanists would place on his specimens. Consequently his herbarium was likely to contain some specimens which had been placed there with less care than had the majority ; moreover, it took many years to accumulate.

It was common knowledge that all the specimens contained in the Linnaean Herbarium were not types and that all his types were not in his own herbarium ; some, for example, were in the Department of Botany in the Hortus Cliffortianus and the Sloane Collections. At the International Botanical Congress held recently at Amsterdam a resolution was passed asserting the importance to taxonomic botany to publish photographs of the Linnaean types in the Linnaean herbarium and at the British Museum. The paper which they had just listened to was an excellent example of the kind of study sometimes necessary to ascertain what were really Linnaean types, and he would like to congratulate Mr. Savage on the results of a sound and laborious investigation.

Dr. A. B. Rendle congratulated Mr. Savage on the continuance of work on the Linnaean collections and on his interesting discovery bearing on the typification of Linnaeus's species. He also emphasized the importance for taxonomic work of an expert comparative study of the Linnaean herbarium in relation with the 'Species Plantarum' and present-day botanical nomenclature.

Cosmic rays and the origin of species.

By Dr. H. Hamshaw Thomas, M.B.E., F.R.S.

Any new information which may bear on the question of the origin of species is worthy of scrutiny. Our present knowledge favours the idea that while species are very constant within circumscribed limits over long periods of time, mutations may occur, often associated with nuclear changes. Many efforts have been made to produce mutations by experimental treatment, but the only method which has so far given constant and measurable results is that involving treatment with short wave radiations or with the high speed electrons produced by radioactive bodies. This treatment appears to have produced similar cytological changes and comparable morphological variations to those which have been observed in nature, but natural radiation has seemed too small in

amount to be effective. Recent researches on cosmic rays indicate that ionizing radiation is constantly reaching the earth, and while its amount at sea-level is small it increases more or less exponentially with increasing altitude. Moreover, what are termed bursts and showers have been observed on mountains which produced an ionization comparable to that of the X-rays used in the experiments by which Goodspeed and Olsen produced mutations in *Nicotiana*. The variation resulting from X-ray treatment appears to be proportional to the ionization produced by the dose, so that if variation is produced in nature by the action of cosmic rays on plant nuclei we should expect to find it increasing with altitude. Cosmic ray effects may be produced at sea-level, but changes due to the bombardment of a chromosome by an electron would be subsequently noticeable only when the chromosome formed part of a gamete. Even then the evidence of X-ray experiments suggests that a viable mutation involving morphological change would be extremely rare, while in nature only a minute fraction of the progeny of any individual plant survive. A preliminary survey suggests that a correlation may be possible between the rate of ionization by cosmic rays on mountains and the variation of species in the vegetation, but the data need much more careful collection and scrutiny.

Evidence of a great variability at high altitudes seems to be furnished by Vavilov's researches on the supposed centres of origin of cultivated plants. In seven or eight different regions of the world a large number of varieties are to be found at high altitudes, even though the crop is less extensively cultivated in those regions than elsewhere. This seems especially true for wheats in the Old World and for maize and potatoes in the New.

The study of wild plants from this aspect leads to the comparison of the numbers of species in the floras of lowlands and of high mountain regions with comparable habitat conditions. Accurate figures are not immediately available, but in many regions where plant-growth can proceed normally at very high altitudes the floras are exceptionally rich. Costa Rica is a very small area but of considerable average altitude, with mountains rising above 11,000 feet. Its flora is not fully known, but includes more than 6,000 species of vascular plants, many of them endemic. Its mountains are of comparatively recent origin, the country having been submerged in late Eocene and Oligocene times.

Evidence may be sought by comparing the numbers of mountain and lowland forms in a genus. Professor Wright Smith's Hooker lecture on *Primula* showed that while the section Vernales is very widespread in lowland areas it contains

only nineteen species: the section Petiolares with sixty-six species, and the Nivales with sixty-one, are mountain forms. There are about 330 species of primulas confined to high altitudes, including a very large proportion of endemics.

The significance of endemic forms, which are so often found on mountains, is uncertain in the absence of closer analysis. There can be no doubt that many endemics like *Matonia* or *Neviusia* are relicts of types which formerly had a wider distribution, but on the other hand it seems certain that other forms like *Spartina Townsendii* and the tetraploid forms of *Biscutella laevigata* are of recent origin. Cockayne considered that fifty-eight per cent of the endemics of New Zealand (forty-three per cent of the whole flora) could be considered as of comparatively recent origin, and the majority of these belong to the high mountains. Jepson has recently drawn attention to the endemics of California, where some 2,000 species, representing forty per cent of the flora, are relicts or indigenous endemics. He considers that the most abundant production of new forms is associated with successive uplift and subsidence of fault blocks, but notes that some species seem to have been raised from 1,000 to 6,000 feet without morphological change.

The distribution of endemics on mountains between latitudes of 48° N. and 50° S., noted by Willis, suggests that they may be largely confined to those places where the climate allows or has allowed plant-growth at a height at which the cosmic ray activity is appreciably greater than at sea-level. Many of the islands renowned for their endemics have high mountain peaks. The persistence of endemic forms may be explained by isolation, or perhaps by the more open habitats in certain montane or alpine zones, but such considerations do not fully account for the origin of these types.

The geological history of the world's floras often shows that a considerable number of new fossil plants appear when one passes from one group of strata to the next, even though there is little evidence of climatic change. These sudden changes may be associated with mountain building. The Upper Cretaceous and Eocene floras of the United States are interesting in this connection.

It is quite possible that the apparent evolution of new forms on mountains is due to temperature changes, and has nothing to do with cosmic rays, but this view is without experimental foundation, and there must be lowland areas in which comparable temperature fluctuations occur or have occurred in the past in connection with the Glacial Epoch. If, however, variation or mutation is brought about or accelerated by cosmic radiation it ought to be demonstrable by suitable culture experiments at very high altitudes. In the

meantime the suggestions now advanced should add a new interest to researches on the floras of the high mountains of the tropics and warm temperate zones.

Prof. E. W. MacBride said that Dr. Hamshaw Thomas had given them a most impressive and comprehensive account of the various experiments, which had resulted in the production of mutations by exposure of eggs to X-rays. He had suggested that mutations might be produced in nature by specially intense bursts of cosmic rays at high altitudes, such as mountain tops, and that thus the origin of species might be accounted for. There were, however, insuperable objections to this conclusion from the zoological point of view. The arrangement of species with their subdivisions of subspecies and biological races was so similar in the animal and vegetable kingdoms as to force the conviction that the same general cause had led to the formation of species in both kingdoms. Now in all experiments exposure to X-rays had killed the majority of the germs exposed to their influence, but a few damaged and weakened specimens had survived, and from these the mutations had been produced. When, however, a new species appeared in nature it was distinguished by its vigour, and it spread at the expense of pre-existing species. Moreover, they had in zoology—what did not exist in botany—lineage series of fossils which were an exact and detailed record of the actual course of evolution. These series taught them that species never originated by sudden jumps or 'mutations' but by slow almost imperceptible changes which were functional reactions to a slowly changing environment—the Chalk Heart-urchins (*Micraster*) were an instance in point.

Dr. Hamshaw Thomas had alluded to Dr. Willis's work 'Age and Area', in which Dr. Willis had also assumed the origin of species on mountain tops by sudden changes. But Dr. Regan some years ago had subjected the evidence adduced by Dr. Willis to the most searching criticism, and had shown that isolated species on mountain tops were not 'new creations' but relicts of more widely spread species adapted to colder climates which had been driven up the mountains by the gradual amelioration of the climate.

Dr. G. P. Bidder suggested that there is possibly an easier means of testing the hypothesis than by examination of the relative frequency of mutation on plains and on elevated table-lands. Windborne pollen and minute spores must frequently be whirled up to the height of 5,000 or 10,000 feet. There they will be exposed to at least the same density of cosmic rays that they would meet on a table-land of equal height above the sea. Unless for some unknown reason they are killed by so long a sojourn at that height in the air,

it would appear that, if the hypothesis be correct, plants propagated by windborne pollen or spores should show more frequent mutations than allied genera of which this is not true.

Dr. J. C. Willis said that he had never actually counted the endemics of mountains, but though there were so many on islands, these were so largely mountainous that he would have thought that probably at least 70 per cent of endemics were connected with mountains.

Professor R. R. Gates said that the thesis of Dr. Hamshaw Thomas was a very interesting one, and he regretted there was not time for a full discussion. He pointed out that there was abundant evidence of mutations occurring in wild species under natural conditions, but he would mention only the classical cases of *Drosophila* in animals and *Oenothera* among plants. When he was in Russia in 1926 the Russians were describing a number of mutations from the eggs of females taken directly from the wild. The Trans. Linn. Soc., Zool. for 1915 contained a paper by Lamb on the Diptera of the Seychelles in which were described a number of new species of *Drosophila*. In several of these the specific characters were strikingly similar to and parallel to some of the mutations of *D. melanogaster*. For three years he had been growing *Oenothera* cultures from wild seeds collected in various parts of Canada. These produced a number of mutations directly from wild seeds, and some of them were precisely parallel to the mutations of *Oenothera Lamarckiana*. It was therefore to be hoped that we had heard the last of the argument that mutations were in some way a result of cultivation or bad conditions.

The widespread frequency of polyploidy in flowering plants was now well recognized, and it often began with a doubling of the chromosomes. This appeared to be connected with extreme conditions of heat or cold, and probably had nothing to do with cosmic rays. Trisomic mutations, arising through non-disjunction of a chromosome pair in meiosis, were also probably independent of cosmic rays. As species appear to have definite mutation rates it was possible that many genes mutate spontaneously without the intervention of rays. This view was supported by the fact that some genes, e.g. for striped flowers, mutated somatically with a very high frequency.

The view of Dr. H. Thomas that mountain tops had a higher proportion of endemics, and therefore of mutations, than lowland floras, owing to the greater frequency of cosmic rays, was certainly worth further investigations, but some facts appeared to militate against it. For example, the Amazon valley had one of the richest floras in the world, with many endemic species, yet it was practically at sea-level, under conditions where cosmic ray effects might be expected to be at a minimum.

Professor F. E. Weiss expressed his appreciation of the interesting way in which Dr. Thomas had dealt with a somewhat novel subject. He referred to De Vries's statement that 'The origin of species is a subject of experiment', and hoped that at the high altitude laboratory established on the Jungfrau in Switzerland some experiments might be undertaken to test the suggestion of Dr. Thomas that cosmic rays might be instrumental in causing mutations in plants.

Dr. Stanley Kemp asked how Dr. Hamshaw Thomas would explain the evolution of a cave fauna.

In reply to a question by the President, Dr. Thomas said that he believed that the first suggestion that cosmic rays might have influenced organic evolution was made by Prof. H. H. Dixon in a letter to *Nature* (1929, p. 981). Professor MacBride had suggested that the succession of fossil animals indicated evolution by gradual change, and this disposed of the evidence from plant mutation, but this view could not be accepted. Different organisms showed vastly different degrees of complexity in organization, and the term 'species' might not mean the same thing in all of them. Among the lower algae specific differences may depend on the shape of a single cell; among the mosses species are often differentiated by differences in the form of a small group of cells; in the flowering plants differences in relative growth rates of cells or organs may suffice to distinguish species; but in the more highly organized animals such small morphological changes would often be of no account. A mutation may produce very little change in external morphology, but is interesting because it is a sudden jump even though a small one.

Whatever might be said of the significance of animal variation under conditions of artificial culture, botanists would scarcely agree to the proposition that variation in cultivated plants had little or no importance when we seek for an explanation of the origin of species in nature. The origin of *Primula kewensis* in cultivation seemed comparable to the origin of *Spartina Townsendii* in nature.

Attention had been drawn in the lecture to the so-called lethal mutations produced by X-ray treatment, and it is quite possible that such lethal variations have played an important part in nature. It must always be remembered that we have to account not only for the appearance of new forms but for the disappearance of old forms. X-ray treatment had produced stunted forms of plants comparable to those often found in high alpine situations, but occasionally very large and vigorous forms had been produced.

Dr. Thomas felt that a detailed and critical study of every aspect of evolution was needed: he hoped that his contribution would stimulate further research.

5 DECEMBER 1935

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 21 November 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Francis Edward Lloyd and Ronald Winckworth.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Tiruvilandur Srinivasa Raghavan ; for the first time, in favour of Bernard William Harrison Coulson.

The following candidates were balloted for and elected Fellows :—Cicely Kate Ricardo, William Watt Addison Phillips, Hampton Wildman Parker, B.A., William Albert Setchell, Ph.D., Atulananda Das, Rev. Father Thomas Paris, John Walker Walton, Harold Downes, M.B., John Evan Adlard, Hirendra Kumar Nandi, M.Sc., James Harold Turner, Walter Lawry Waterhouse, M.C., D.Sc., Frederick Kirkwood Makins, B.A., and General the Right Hon. Jan Christiaan Smuts, P.C., LL.D., F.R.S.

The BOTANICAL SECRETARY showed a specimen of parsnips which had been received in the Department of Botany, British Museum (Natural History), from Dr. T. Bryan of Lewes. Two parsnips of normal size passed through the small holes of the flange of a hinge. This had apparently been lying in the soil and parsnip seeds had germinated above it. The radicles of two seedlings had passed through the holes and growth had thus proceeded normally except for the great constrictions which occurred in such a way that the hinge appeared to be inserted in the parsnip !

Changes in the British Fauna and Flora during the past fifty years. (Joint communication.)

(1) Mammals. By Mr. M. A. C. Hinton.

Mr. M. A. C. Hinton, in opening the discussion, said it was not possible to get full and trustworthy information as to the position fifty years ago ; it was not possible to get it even for the present position. Work in a Museum will not give this information : there, one is in danger of forming such opinions (based on the contents of the Museum mail-bag) as that albinism is tending to increase among moles and that Dormice and Harvest Mice are becoming scarcer and scarcer. Nothing but a National Biological Survey, on a really adequate scale, or better a National Union of Field Naturalists, with strong local committees and a good central nervous system, can procure such full information.

But this very lack of information enables us perhaps to present a more convincing picture of the changes which have taken place within the period in question than would be possible with full data.

As regards the mammalian fauna the changes of the last fifty years appear in the main to be attributable to four chief causes :—

The first and most important is the rapid growth of the Towns and in recent years the construction of new highways and ribbon development. As a result of this the space available for native species has been restricted and it continues to dwindle rapidly. On the other hand, this ' progress ' is providing more and more accommodation for the alien parasites, *Rattus rattus*, *R. norvegicus*, and *Mus musculus*, and for *their* parasites, and the facilities for their dispersal throughout the land are improving steadily. The replacement of *R. norvegicus* by *R. rattus* as a consequence of rebuilding our cities has been described on a previous occasion (Proc. Linn. Soc., Sess. 144, 1931–32, p. 119).

The second cause of change is the clearance of forest, woodland and crofts. This has affected only certain areas, e.g. Sutherland, where it has been carried out chiefly in the interests of sport. In such areas this clearance and the systematic persecution of carnivores have resulted in marked change in the composition of the mammalian fauna. The rarer elements have been almost entirely suppressed, and their place taken by myriads of hares, field mice, and voles. The War granted a respite to the Carnivora, and the Wild Cat, which but for that event would probably have been exterminated by now, increased in numbers. But now the persecution of this animal and other carnivores is in full swing

again ; and apart from a slight possibility of help coming from the third cause of change, dealt with below, it is probable that the Wild Cat will be brought to the verge of extinction again before long.

The third cause of change is one that has developed in recent years thanks to the work of the Forestry Commission. Many thousands of acres in the Highlands have been planted with conifers ; and in these plantations Pine Martens and Red Squirrels are said to be increasing.

The fourth and last cause of change is that of intentional introduction. In recent years we have had Skunks farmed on Dartmoor ; whether any of these have escaped or not is unknown at present. Indian and African Mongooses have been trapped in Perthshire. A Viscacha was shot on the marshes of the Parrot in Somersetshire. Nutria and Musk Rats have been farmed in many places and considerable numbers have escaped. The present position with regard to the Musk Rat is quite uncertain. The activities of the Ministry of Agriculture in the Shropshire and Sussex areas are claimed to have almost eliminated this unwanted colonist ; but nothing is known about the position in other parts of the country. In central Scotland there is still a considerable infestation. Japanese Deer and possibly the South American Pudu have been introduced ; the former species is said now to be quite abundant and is to be found in all parts of the country.

With regard to Marine Mammals, two things are worth noting. We have had in recent years visits from species (e.g. *Pseudorca crassidens*) not normally resident on our coasts. The causes of their visits lie ultimately in temporary changes in the neighbouring seas, and are, of course, entirely independent of human activity.

Secondly, Grey Seals are said to have increased on the coast of north Cornwall. Mr. Stephen estimates their number at present as about 3,000. The fishermen have made a great outcry against the Seals, saying that the shoals of pilchards are turned away by the appearance of even one Seal in a bay. Probably the substitution of Diesel Engines and out-board motors for sails and oars has far more to do with the disappearance of surface-swimming fish than have the Seals.

Although it is true that the biota is never absolutely stable in any area, there can be little question that as regards terrestrial Mammals in Britain human activity in one form or another is the most important factor of change that exists.

(2) **Birds.** By Mr. W. B. Kinnear.

In the List of Birds published by the British Ornithologists' Union in 1883, 375 species were given as occurring within the limits of the British Isles. At the present time there are 514 species and subspecies on the list. This increase is partly accounted for by the recognition of local races, which in some cases means that instead of one bird there are two on the list, the British resident race and the Continental winter visitor or passage migrant. Then in addition many new birds have been added mainly through the increased attention paid to the study of migration.

On the debit side I think we have only to place two species, the Osprey (*Pandion haliaëtus*) and the White-tailed Sea Eagle (*Haliaetus albicilla*). Within our half-century the Osprey nested in several places in Scotland, the most famous being Loch an Eilan in Rothiemurcus forest in Invernesshire, which was deserted in 1903. The only other contemporary breeding place was at Loch Arkaig in West Invernesshire, but in 1903 only a single bird turned up, and for eight years this lone bird regularly returned every spring, remaining about the loch all summer, till the year 1911, after which it was not seen again. Fifty years ago a few pairs of the Sea Eagle nested on the coast of north-west Scotland and in the Shetlands, but shepherds, gamekeepers and collectors were too much for it. Soon it ceased to nest on the mainland, but in the Shetlands, however, the Sea Eagle continued to breed until about 1908 when the male was killed and the female (which was almost entirely white) lingered on until 1918, after which it disappeared.

Certain other birds are undoubtedly found in fewer numbers than formerly, but if given a chance will probably return to their old status. We have the case of the Lapwing (*Vanellus vanellus*), a bird about which considerable correspondence took place in the press a few years ago, and eventually the eggs were specially protected by Act of Parliament. Whether this has had any beneficial effect it is difficult to say. Then there is the Corncrake (*Crex crex*), a scarce bird now in the S.E. of England and other parts of the country, but still holding its own in Wales and the West. The early harvesting of the hay crop has been blamed for the bird's decrease.

During the War all kinds of birds of prey increased owing to the absence of game preservation. This was especially noticeable in Scotland, where Golden Eagles, Buzzards, Peregrines, and Merlins became more numerous than they had been for a long time. Soon after the War, however, they were greatly reduced in numbers again, but none of them are yet in any danger. Some years ago the Common Buzzard

was a scarce bird in the south-west of England, now many pairs nest annually in Devon and Somerset.

As regards breeding species the most noticeable increase has been in the Fulmar Petrel (*Fulmarus glacialis*), Great Crested Grebe (*Podiceps cristatus*), British Greater Spotted Woodpecker (*Dryobates major anglicus*), Black-necked Grebe (*Podiceps nigricollis nigricollis*) and many species of Duck.

The Fulmar Petrel (*Fulmarus glacialis*) has been known for nearly 300 years as a very abundant inhabitant of St. Kilda, where a heavy toll was taken of it annually by the inhabitants for the sake of the oil, feathers and flesh. First it spread to Sulisgeir and North Rona about 1887 and then to various other smaller islands. It bred on Foula in 1878 and from there spread to the Shetlands, and by 1908 all these islands were colonized. The Orkneys followed and one of the first nesting places on the mainland was at Dunnet Head in 1900. Since then it has spread down the east coast as far as Flamborough Head on the Yorkshire Coast, where it bred in 1919. On the west coast it reached Donegal in 1910 and Galway in 1932, and has since been seen haunting the Pembrokeshire cliffs in summer. Not only has the Fulmar extended its breeding range, but the numbers at the different breeding stations have also greatly increased. Professor Ritchie suggests there may be some connection between the introduction of tinned provisions into St. Kilda and the increase of the Fulmar!

An enquiry took place some years ago into the present distribution and increase of the Great Crested Grebe (*Podiceps cristatus*), and according to the report by Messrs. Harrisson and Hollom, it has been steadily increasing since 1865. Prior to 1840, 21 lakes in England were colonized and by 1931, 429 new ones were occupied. This increase is said to have taken place in cycles. In Scotland it first bred in Perthshire in 1887, then between 1879–1881 spread to Fife and gradually increased over much of the country, reaching Elgin in 1913, and is still spreading in the north and south-west.

In 1915 a young bird of the year of a Black-necked Grebe (*Podiceps nigricollis nigricollis*) was shot in Ireland, and three years later a pair in full summer plumage with three young were obtained. In 1929 a breeding colony was discovered on a secluded lough: fifty birds were counted, 16 nests with eggs found, and some old birds with young seen. The lough was between two and three miles long and half a mile at the widest part in a remote part of the midlands of Ireland. In 1930 there were estimated to be 150 pairs on the lough. Either last year or the year before I believe the lough was dried up. In Wales five pairs with young were seen in 1904, and 1927 they were still nesting, though in decreasing numbers.

At Tring this Grebe first nested in 1918, but the colony does not seem to have flourished, and in 1929 and 1930 only one pair was seen and no young hatched. In Scotland a single bird was seen in the Forth area in July 1928, two pairs in 1929 and two pairs at least bred in 1930.

The British Greater Spotted Woodpecker (*Dryobates major anglicus*) was described by Macgillivray in 1840, as 'in all parts rare' in Scotland, and apparently it died out about 1850–51. Between 1878 and 1879 there is some evidence to show that it was making an endeavour to return, but it was not till 1887, when it bred in Berwickshire, that the return movement really began from England. Since then it has gradually spread north, and is now found as far as East Sutherland. In the west, however, the Nith appears to have been a boundary for a long time, and it was not till 1918 that it extended its range into Galloway, where it is now not uncommon. Various suggestions have been made for the bird's disappearance, such as the destruction of forests, great increase of squirrels, etc.; but I do not think anything has been proved.

The Great Skua (*Catharacta skua skua*) in the past only bred on Foula and Unst, in the Shetlands, where it was very carefully protected. Now it has spread to various other islands in the group, and since 1914 to the Orkneys. So numerous has it become that a year or two ago the County Council of the Shetlands removed it from the protected list, except in one or two islands. This increase seems to have been due to protection of the nesting birds.

Then amongst the Ducks there has been a general increase, especially as regards the Tufted Duck (*Nyroca fuligula*). About a century ago Grey Geese (*Anser anser*) were quite unknown in County Down, Ireland, now they are very abundant, and the Bean Goose (*Anser fabilis fabilis*), which was formerly numerous, is very scarce. According to Dr. John Berry there has been absolutely no alteration in the local conditions to account for the amazing rapid increase. In North Uist, Outer Hebrides, however, the story is different, and up till about 1919 Grey Lags nested and came in their usual numbers in the autumn. Then about 1922 the breeding geese decreased, also the number of the migrants. The Barnacle-Goose (*Branta leucopsis*), which used to be a common winter visitor, has also ceased to visit North Uist. On the Solway the Bean Goose seems to have replaced the Grey Lag, and this is accounted for, I understand, by a change in the feeding grounds.

The Goldfinch (*Carduelis carduelis britannica*), which formerly suffered much from the activities of birdcatchers, is now quite common. The Bullfinch (*Pyrrhula pyrrhula nesa*),

on the other hand, fluctuates greatly from year to year. The Crested Tit (*Parus cristatus scoticus*), for years confined to the old fir forests in the Valley of the Spey, gradually spread north to Fochabers, near the mouth of the river, and then westwards along the Moray Forth to East Ross, where Mr. Ogilvie Grant found it in 1915.

The Starling (*Sturnus vulgaris vulgaris*) is a bird which has increased enormously of recent years. Early in the 19th century it was not a common bird in parts of England—indeed, it was entirely absent from some places in Scotland. There is, however, some evidence to show that previously the Starling was well known, where a hundred years ago it was absent.

In the Outer Hebrides and Shetland a different race (*Sturnus vulgaris zetlandicus*) always seems to have been common there. Vast hordes of Starlings come to our shores from the Continent every autumn, but whether the enormous numbers which roost in and about London are of Continental or British origin is unknown. From ringing records, however, we know that many of the British-bred birds winter in Ireland and many, which have been reared in Scandinavia or Baltic Provinces, come to this country for the winter. I do not know if there is any evidence to show whether more Starlings come to this country from the Continent than formerly.

Introductions.

Of introductions within recent years only the Little Owl, *Athene noctua vidalli*, need be mentioned. Introduced at Edenbridge, Kent, about 1874 and at Oundle, Northants, some years previous to 1889, it has now spread to nearly every county in England and Wales and on the Scottish border.

Change of Habits.

Amongst the Gulls we find that within comparatively recent years certain species have changed their feeding habits. The Herring Gull (*Larus argentatus argentatus*), for instance, now competes with the Rooks for the grubs laid bare by the plough. Writing in 1889 Howard Saunders remarks in his Manual of British Birds that the Herring Gull 'may sometimes be seen inland searching for worms, grubs, and newly sown grain'. This is now a common practice, and Herring Gulls are a common sight on ploughed fields, often far inland. The feeding on grain is quite a recently acquired habit. The hard winter of 1894–5 attracted many Black-headed Gulls (*Larus ridibundus ridibundus*) to the Thames, and people watching the ice on the river began to feed them. From that year dates the winter invasion of the Black-headed Gull to London. The Herring Gull followed some years

later in the track of the Black-headed and more recently the Common Gull (*Larus canus canus*). Within the last few years the Lesser Black-backed Gulls, both the British (*Larus fuscus graellsii*) and Continental (*Larus fuscus fuscus*) races, have taken to making quite a prolonged stay on the river, especially between Putney and Richmond, on their autumn migration south.

A bird which has become more numerous as a breeding species and at the same time changed its nesting habits is the Oyster-Catcher (*Haematopus ostralegus occidentalis*). These birds haunt most of the northern rivers for breeding purposes, making their nests on the shingle banks and islands. Owing to all the available sites being occupied in the river beds the bird has spread on to the adjoining ground, and at Blair Atholl on the Garry, for instance, I was informed it had taken to nesting on the hillside some hundred feet or so above the river. In Dumfriesshire the river Nith does not provide sufficient nesting sites, and the birds have now betaken themselves to the grass fields.

(3) Insects. By Dr. K. G. Blair (Visitor).

Compared with the few dozen species of Mammals and the few hundred of Birds dealt with by the previous speakers we have thousands or even tens of thousands of species of Insects in the country, so that in this brief paper groups of species rather than individuals will be considered. Even so most of the examples given will, on account of lack of records in other orders, have to be taken from the Lepidoptera and the Coleoptera.

Insects that are strictly localised in their habitats are obviously in greater danger of extermination than those of more general distribution, and the extermination of the Large Copper Butterfly and other fenland insects was briefly discussed, the burning of Whittlesey Mere in 1854 and the drainage soon afterwards of this and other fenland areas, and also the cessation of the annual cutting of the reeds were considered to be contributory causes. The expansion of the large towns had also destroyed the habitats of many local species, the Hammersmith and Battersea marshes and the Isle of Sheppey being instanced. The beetle population of the shore belt around our coasts was suffering very severely not only from the oil derived from the numerous oil-driven vessels, large and small, brought in by the sea but also from the depredations of trippers churning up the narrow habitable belt.

In the case of insects of more general distribution extermination was not only rarer but slower in operation, but

the Black-veined White and Mazarine Blue were mentioned among the butterflies as well as the Field Cricket and the sawfly, *Athalia rosae* L., formerly a pest of cruciferous crops. In view, however, of the scanty knowledge of the distribution of some of these species, and of the large areas of the country almost unworked entomologically, many of these may not be really extinct and may yet recover their position, as the Comma Butterfly, the Large Tortoiseshell and other butterflies, the Dragonfly *Ischnura pumilio*, and many beetles seem to be doing.

On the other hand, many insects have been introduced and have established themselves in the country either by natural immigration, as the moth *Plusia moneta*, or by commerce; sometimes spreading at large, as some of our timber beetles, e.g. *Criocephalus polonicus*, *Tetropium gabrieli*, and *Melanophila acuminata* in our southern woods, the bullet-gall of the oak, *Cynips kollari*, and the Solomon's Seal sawfly, *Phymatocera aterrima*; sometimes remaining as warehouse pests, e.g. *Ptinus tectus*. Others, already indigenous, have extended their range, e.g. the beetles *Asemum striatum*, *Pissodes notatus*, *Tomicus nigritulus* and others, formerly confined to the pine woods of Scotland, have now spread to the pine woods of the south. It is reported that in the Plymouth district the weevil, *Barypithes pyrenaeus*, has replaced its congener, *B. brunnipes*. Certain exotic species have also established themselves out of doors, e.g. the Australian Weevil, *Syagrius intrudens*, near Dublin and at Horsham, a species as yet unknown as endemic in Australia, the oriental *Anthicus tobias* and the Japanese *Philonthus rectangulus*, as well as the House Cricket and the domestic Cockroach on rubbish dumps in many parts of the country, while the North American leaf-hopper, *Graphocephala coccinea*, may be expected to do the same.

But by no means all the additions to the British list are to be reckoned as accessions to the British fauna, many having been hitherto overlooked either through confusion with allied species or owing to their retiring and specialised habits; many of the inhabitants of the nests of moles and other small mammals, of ants' nests, etc., may be cited as examples. In the case of little-worked groups it is often impossible to say whether an insect is a recent arrival or has been merely overlooked. The Psocid genera *Pteroxanium* and *Embidotroctes* are such cases.

In conclusion, the need for records was stressed, records not only of the occasional occurrence of rarities, but of the annual fluctuation in numbers of some of the commoner species, records best accumulated by local societies throughout the country. A start in this direction has been made by the

Victoria County Histories, but is very far from complete, and in all cases requires constant revision and extension.

(4) Flowering Plants. By Mr. A. J. Wilmott.

It is impossible in fifteen minutes to deal adequately with fifty years of change in the flora of the British Isles. My remarks must be limited to a consideration of the various factors responsible for changes and a mention of the species most conspicuously involved. Even in a country so comparatively well investigated as ours, the flora is insufficiently known to permit any detailed estimate of change.

The extension of communications and ease of travel, the invention and spread of the motor car, have naturally brought considerable changes in their wake. The attack on the wild flowers has been sufficient to produce bye-laws and schedules for the protection of the flora. Generally or locally abundant plants such as Primroses and Daffodils have been dug up for gardens and extreme rarities are visited by car in such numbers as in one case at least to produce a track by which the habitat can be found by a visitor ignorant of it. Great deforestation during the war, road widening and destruction of verges, a passion for cleaning up the country roads, drainage schemes, and other concomitants of civilisation, all tend to the destruction of the native flora. Yet if we seek for the species which have become extinct during our period of fifty years, we find there are very few :—*Senecio palustris* has followed *S. paludosus* by fen drainage, *Pinguicula alpina* by forest extension in W. Ross, *Lathyrus niger* from Perthshire (reason unknown, possibly over-collecting), possibly *Orchis militaris* by over-collecting. Certainly many species have been reduced in numbers, and several rarities are on the danger list, e.g. *Potentilla rupestris* (quarrying and consequent desiccation of Breidden Hill, as well as collecting), *Erythraea tenuiflora* (gone from one of its two stations), *Orchis simia*, *Cypripedium*, *Cephalanthera rubra*, *Spiranthes aestivalis* and *gemmipara*, all but the first in no danger except from over-collecting. Over-collecting includes the casual plucking of the conspicuous flowers by children—increasingly taught 'Nature Study' in the schools—and extirpation by florists for sale to gardeners. One species at least definitely increased during the war. The so-called 'alpine gardener' is a menace to any flora : not only are cart-loads removed from the Alps but our own mountains are despoiled of their rarities : [all stock should be raised from seed : a guarantee against the enormous wastage due to the sale of plants which cannot be kept alive]. The rock ledges of Lawers and Clova are said to be poor

compared with their state fifty years ago. In less danger are those of our varieties which are seasonally variable, rare some seasons but occasionally abundant, e.g. the 'Lizard' Trifoliums, which exhibit delayed germination: such species are comparatively safe from extinction.

Two agricultural pests are very rare and temporarily extinct since they are notifiable diseases, viz. *Cuscata epilinum* and *C. Trifolii*. Cleaner agriculture has, in most of England, destroyed the fields golden with corn marigold, scarlet with poppies, azure with cornflowers, purple with corncockle—all these species now quite uncommon in large areas: the only loss is *Delphinium Gayanum* (wrongly called *D. Ajacis*), now only to be found as a casual. Urbanisation produces local loss of interesting plants—scarcer because they demand a special habitat—and leaves only the ubiquitous hardy natives, weeds, and aliens; but the only more general loss from this cause that I note is that of *Simethis* at Bournemouth. Road-making also produces local losses, but has produced local increases of interesting viatical plants, e.g. *Bromus maximus*, *Senecio viscosus*. Possibly, the chief general change is due to the increasing dryness, which is said to be quite definite both in Scotland and Wales. Whether there has been any climatic change I cannot say—the change may be due to a combination of drainage, deforestation, and the closer cropping of hills by the sheep which have largely replaced the cattle. The Grampian and other schemes may increase this desiccation. *Scheuchzeria* is now unknown except on Rannoch moor: *Liparis* has diminished with the drainage of the fen country. On the other hand, *Inula salicina* on Loch Derg has survived the flooding caused by the Shannon Scheme.

The sea shore is an area of natural change, and certain maritime species may be sporadic as well as local, e.g. *Diotis*, *Mertensia*, *Euphorbia Peplis*. I do not think any have been lost, but *Atriplex pedunculata* is gone from most of its former localities and is on the danger list. For some reason *Zostera marina* has largely died, but it has certainly not disappeared. Here we can begin to examine the other side of the picture, the gains. *Spartina Townsendii*, originating in Hampshire, has colonised vast areas of mud in southern England—it has even naturally extended across the channel—and has been planted out in new areas. Planting out of *Psamma* as a dune stabiliser, and similarly of *Hippophaë* (which does well as far north as Angus), has produced changes which have not affected the flora as a whole.

The gains to the lists of the British flora are many, but they are mostly not gains to the flora itself. Excluding innumerable discoveries in *Rubus*, *Hieracium*, *Taraxacum*,

Rosa, and the smaller critical genera, perhaps I should just mention such interesting additions as the two new *endemic* species of *Statice—transwalliana* (Pembroke and Clare) and *paradoxa* (Pembroke and Donegal),—and also *Koeleria vallesiana*, overlooked for two centuries by all botanists visiting Brean Down for *Helianthemum polifolium*, discovered in the Dillenian Herbarium by Dr. Druce and immediately refound on a post-haste visit to the locality. These show that there is no need to regard such discoveries as *Carex chordorrhyza* in Sutherland, *Carex microglochin* and *Schoenus ferrugineus* in Perthshire, *Utricularia ochroleuca*, *Limosella subulata* and the like, as additions to the flora in the last fifty years. Some gains to the list may or may not be gains to the flora : there is no evidence either way for making judgment :— *Hydrilla verticillata* discovered in Esthwaite water, and this year in Connemara, *Scorzonera humilis* in Dorset, *Erythraea portensis* in Pembrokeshire, *Tillaea aquatica* in Yorkshire— who can say more than that water plants are both easily missed and easily spread, Pembrokeshire comparatively unknown, and *Tillaea* very inconspicuous. *Naias graminea* (an Egyptian species) appeared near a warm effluent in a canal at Reddish (Lancs.), and has, I believe, disappeared again. *Ranunculus ophioglossifolius*, having been lost in Jersey, has reappeared in southern England and is now preserved. *Veronica praecox* has recently been found in East Anglia, and is abundant in three considerably separated localities : if it is not found in old herbaria it must be deemed a recent gain, possibly sown with foreign seed. *Spiranthes Romanzoffiana* was discovered on Lough Neagh in many localities within a few years : one locality was much traversed by botanists seeking another rarity and the plant was conspicuous in flower. It has since been found in Colonsay : has it been overlooked or is it a recent arrival, spreading as arrivals frequently do ? *Eriophorum alpinum*, long lost in Angus, has been reported from Ross : intensive search of the area indicated reveals a probable error in identification rather than a gain to the flora. *Eriophorum opacum* from Ross, on the other hand, is vouched for by specimens. *Luzula pallescens* (and perhaps the so-called *Viola montana*) in Woodwalton Fen is probably a recent arrival, as certain not very old maps indicate the area as arable land. As due to some unknown method of introduction must be reckoned *Sisyrinchium californicum* in Wexford, *Ledum latifolium* in some northern bogs, *Orobanche reticulata* in Yorkshire, *Ajuga genevensis* in Berkshire. *Prunella laciniata* and *Lotus siliquosus* were found in several southern counties, in each case within a space of a few years, and are therefore probably recent arrivals.

Time does not permit me to deal with the species which have increased or decreased in known range, interesting as some of the extensions may be, e.g. *Juncus pygmaeus* previously known only as one of the Lizard specialities, found this year in the isle of Raasay, north of Skye. Most of these species have probably been overlooked, and no actual extension of range is concerned. But one or two cases are of interest, e.g. *Lobelia urens*, long known in the Cornish peninsula, has been found in Hampshire (two localities) and Sussex : *Danaë cornubiensis* of Cornwall is known at Burnham Beeches (Bucks) : *Sisyrinchium angustifolium*, suspect by some in Ireland, has been found in several English counties : the Breckland *Veronica triphyllos* and *Holosteum umbellatum* have been found in Surrey. *Corynephorus canescens*—previous northern limit on the Norfolk dunes—is found by the Moray Firth. Have these spread, or have they been overlooked ? Afforestation is probably responsible for certain extensions of range. *Goodyera repens* in pine wood in East Sutherland was no doubt introduced with the trees (from Braemar) : there was no native pine wood in East Sutherland : the same thing presumably occurred in Norfolk. *Illecebrum* in the New Forest may have had a similar origin : of its occurrence in Berkshire I have no personal knowledge. The extensive afforestation in the East Anglian ' Breck ' country has aroused fears for the safety of the peculiar floristic element of that area. A discussion similar to this in fifty years' time may have some evidence before it, but the fears are probably groundless.

An enormous number of aliens have been recorded : grain aliens ; dock aliens ; refuse tip aliens ; chicken run aliens ; wool aliens ; and the like. The majority of these do not survive a single winter, but a few have colonised extensively, viz. *Matricaria suaveolens* (to all ends of the isles), *Erigeron canadensis* : *Rumex cuneifolius* native on South American dunes, has arrived as a dock alien and is now colonising our dunes in several areas. The latest, *Epilobium adenocaulon* (American), is still running. Weeds which have completed their establishment are *Veronica Buxbaumii* and *Crepis taraxacifolia*. The railways have been a means of transit to certain plants, e.g. *Linaria minor* is found abundantly along such tracks in the north of Scotland and *Senecio squalidus* has used the Great Western Railway in its travels. A number of garden escapes have colonised considerable areas with success, e.g. *Lupinus ' nootkatensis '* on river shingles in Scotland, *Mimulus guttatus* by streams ubiquitously and *Impatiens Roylei* still increasing, *Allium triquetrum* and *Erigeron mucronatus*, which have added themselves as a a pseudo-Atlantic element, *Epilobium nummulari-*

folium (from New Zealand) which I even found high up in the Hag's Glen (Carrantuhuol) in Kerry. *Galinsoga* has become a successful weed round London, and several other less successful escapes might be mentioned here. To conclude, I must mention the harmful activities of the seed-scattering beautifiers of Nature. *Aquilegia alpina* has been sown and still survives high up in Angus: *Mesembryanthemum edule* is wrecking the beautiful cliffs of the Lizard and elsewhere. Even Snowdon is not safe, and new discoveries may be increasingly suspect before the facts necessary for this type of enquiry have ever been accumulated.

The nett result would appear to have been some gain, little loss, but much danger from the varied activities of greedy or ignorant people.

(5) Marine Algae. By Mr. A. D. Cotton, O.B.E.

In common with the previous speakers, I have found it difficult to give a precise account of the changes which have occurred. For reasons similar to those already mentioned, the changes which can be recorded are few. Much more could be said if our knowledge was more precise.

A type of change which need not be dealt with is the differences noticeable from year to year in the floristic components of the shore and the fluctuations of the relative abundance of species. These are common, and often very striking, but are mostly due, presumably, to annual variations in climatic conditions, or possibly even to cycles of climate.

Most of the changes which should be recorded consist in local variations in the composition of the flora, but few details are available. No exterminations are known; on the other hand there are several well-known cases of successful colonization by aliens.

For the purposes of this discussion the changes may be grouped under four categories. 1. General reduction in number of species in given areas (local or widespread). 2. Special cases of reduction or loss of species (local or widespread). 3. General increase in species or of vegetation (local or widespread). 4. Special cases of increase of species or of additions to flora.

Categories 1 and 3 can be alluded to only in general terms.

With regard to 1 (General reduction), there can be no question that certain areas are not so rich in species as formerly. This is largely due to the influence of man, the pollution of water by oil probably being the most important factor; in other localities nitrogen-pollution through sewage disposal systems is very potent. The flora of Weymouth Bay, for instance, has suffered a great reduction in the number

of species, and one knows from herbarium records that there are many other areas where the richness of the flora has been greatly diminished through the development of towns. Some of the reports of the Royal Commission on Sewage Disposal give details as to the type of flora found in water heavily polluted by nitrogen. In most cases a definite reduction in the number of species may be assumed to have taken place, though, on the other hand, certain algae flourish and increase, both in number and in vigour, in waters thus polluted. Such problems may be studied specially in estuaries and semi-landlocked areas, such as Southampton Water.

Under category 2 (Special cases) local changes due to alteration in shore-topography may be mentioned. Shifting mud-, sand-, or shingle-banks may bring about reduction or even local extermination of species, though new areas bearing a similar type of flora may develop elsewhere.

Another special type of reduction is caused by the colonization of extensive areas by *Spartina*. The pre-existing algal flora, which, though poor in numbers, contained interesting species, must have been largely destroyed.

One case of disappearance of a rare species in a definite locality may be mentioned. *Codium adhaerens* is plentiful in the Channel Islands, Cornwall and Ireland, but its only known station west of Plymouth was Durlston Head, Swanage. The plant was known there since 1859. It is a perennial, and occured in deep pools. I could always count on finding it there up to the time of the War, but when I visited Swanage in 1926 it had completely disappeared. This may be connected with a change in tide-levels, but it is curious that the species did not spread locally. It is possible that it has not been actually exterminated in Dorset, but the fact remains that, as far as I know, in order to obtain specimens of this interesting alga we have now to journey as far as Plymouth.

The only other special instance of loss which I may mention is that connected with the diminution of *Zostera marina*. The wholesale disappearance of Eelgrass over large areas on both sides of the north Atlantic is a most remarkable biological phenomenon. In some places it has absolutely disappeared, e.g. the Fleet, in others very nearly so, e.g. Cork Harbour, Poole Harbour, and in yet others the disappearance is not so marked. *Zostera marina* serves as an habitat for some dozen epiphytes, and most of these occur on other plants, but two are confined to this host. These are *Rhodophysema Georgii* and *Castagnea zostericola*. The first forms microscopic cushions, the second consists of brown strands some two or three inches long. The diminution in the Eelgrass of necessity affects the prevalence of these two interesting algal epiphytes, and over large areas in western Europe and North America they must have completely disappeared.

As to category 3 (General increase), there are probably no important cases of general increase in number of species in a given area. The increase of the green algae, *Ulva lactuca* var. *latissima* and *Enteromorpha* spp., owing to the development of towns, accompanied by nitrogen-pollution of the water, often leads to such extensive development as to be regarded as a case of general increase of the vegetation on a shore previously almost bare. Owing to the colonization of the mud by mussels, *Ulva* finds a means of anchorage, and, held down by the byssus threads of the mussels, increases vegetatively and thrives amazingly in the polluted water. Many acres of *Ulva* may be found in shallow water in various parts of the country, and though no figures are available one may assume that the areas of *Ulva* fields have increased during the past fifty years. This, perhaps, should be regarded as coming under category 4, but the *general* increase of the *Ulva* must be very considerable. It may be added that refinements in sewage-disposal do not necessarily reduce the nitrogen pollution of the water.

Turning now to category 4 (Special cases of increase), the invasion of the shore by fresh species in areas of new salt-marshes, in channels between new *Spartina* areas, and the increase in nitrogen-loving species, such as *Ulva* and others, in polluted areas, may be cited. More striking cases are furnished by colonization by aliens, of which three well-known macro-species will be mentioned.

(a) *Asparagopsis hamifera* is a Red alga, originally described from Japan, from whence it has been regarded as having been introduced to Europe. It is also known from California. It was first collected in Europe at Falmouth (1895), and was subsequently found at Torquay, Weymouth and the Isle of Wight. It has also been listed from Cherbourg and other localities in France and is now an integral part of our south coast flora, though local in its appearance. I was surprised to find it on the west coast of Ireland in 1911, and Mr. Tandy recorded it from Ayrshire in 1928. In Europe female plants only are known (which suggests a single introduction), and propagation is exclusively by vegetative means (fragmentation).

How it was introduced to Europe is unknown, but its spread along our coasts is explained by its curious hooked branches, which enable it to cling on to other algae. The hooks are at first sickle-shaped, but they possess cells on the concave surface which are sensitive to the stimulus of contact. As a result of this stimulus the hooks twist tightly round the fronds of other vegetation.

Chemin has shown that new shoots arise from the hooks when attached to other branches. He also described a new

form (f. *sterilis*) derived from the normal female plant, in which the production of cystocarps is completely suppressed (Rev. Alg. iv. 40).

(b) *Colpomenia sinuosa* is a Brown alga, and widely spread in the warmer seas. It was first recognized on the British coasts in 1908, but it was afterwards discovered that the plant had existed in the Scilly Islands since 1905. It was supposed to have been introduced to England by French fishing-boats, and within a few years after its discovery the plant occurred along the whole coast from Land's End to Poole Harbour. In certain areas it was found in extraordinary abundance, being one of the dominant species.

At the time of the Clare Island Survey it was not present on any of the Irish coasts. It is now abundant at Port Erin, and it is believed to have arrived at the Isle of Man about 1920. Dr. Margery Knight informs me it is now prevalent in south-west Ireland (Lough Ine), and that it has been there for at least four years. How far north it extends on the Irish coasts, and whether it has reached Scotland, is not known.

Colpomenia has remarkable powers of floating and drifting. It is a littoral, epiphytic species, and its sac-like thallus (frond) is spherical, and normally filled with water. If the fronds become pierced at the base the water escapes when they are exposed at low tide, and its place is partly taken by air. On the return of the tide many of these thalli break away from their moorings and float to the surface of the water by means of the air imprisoned in the sac; hence the French name 'ballon'. I have seen hundreds of such 'ballons' floating on the water being driven by the wind or tide. The spread of this species also is therefore easily accounted for.

(*c*) The last species is *Codium mucronatum* (or probably more correctly *Codium fragile*), which has no special features to render it easy of transport. It is a native of the Pacific, occurring in Japan and California, and New Zealand and Australia. Though a very striking species, it was not recognized as British until the time of the Clare Island Survey. Subsequent investigation and examination of herbarium specimens showed that the alga had been present in Ireland for a hundred years, and that it occurred along the whole of the west and north coast of Ireland and along the west coast of Scotland up to the Orkney Islands, and also on the coast of the Isle of Man.

I paid a special visit in 1911 to South Wales, the north coast of Cornwall, and the south coast of Devon and Cornwall in order to ascertain if this *Codium* had been overlooked, and made special enquiries in other localities, but it was completely absent. Up to 1912 it was certainly confined to

our western seaboard and the Isle of Man. It was also absent from the west coast of France and, indeed, from the whole of the rest of Europe and north Atlantic. Its origin on our Atlantic seaboard was an enigma, but my view at the time was, that though it existed in Ireland a hundred years ago, it was probably an alien. Recent records tend to confirm this view. The alga has since been recorded from Holland (1923), and also from the well-worked shores of Denmark (1920) and Heligoland (1935). As far as I am aware, it has not spread much in the British Isles, and has not been recorded from France. It is relatively bulky, and sinks to the bottom of the sea when detached, and is propagated, as far as is known, entirely by spores. As it is not found in the Channel it would appear to have been transported to the North Sea by shipping. This *Codium* is still one of the most interesting cases of discontinuous distribution amongst marine algae.

Another plant which might be alluded to as likely to invade our shores is *Asparagopsis armata*, an Australian species. During recent years this alga has been introduced to the Mediterranean, and has been recorded from the west coast of France, and Cherbourg. In addition to the ordinary fronds, it has special barbed branches which, by the aid of adhesive disks, serve as organs of attachment. These, doubtless, have facilitated its spread in Europe, and also probably account for its introduction.

(6) **Fungi.** By Mr. J. Ramsbottom, O.B.E., Sec.L.S.

In attempting a profit and loss account for fungi during the past half century one meets with difficulties somewhat different from those mentioned in other groups. There have been hundreds of species added to our lists, some of them newly described, but it is not possible to judge with certainty which are really introductions except in a few instances.

On the other hand it is unsafe to say that any particular species has been lost to our Flora. Fruit-bodies often require very special climatic factors for their production, even though the mycelium may be perennial in the soil or in wood. Some fruit-bodies, of Agarics for example, have been seen only once, but even the commonest species have their lean years, when they may not be encountered in the course of an autumn's field work.

Amongst Basidiomycetes we cannot speak with any certainty except for Gasteromycetes of such peculiar form that they would arouse the interest of the most casual observer. Four of these have been added to our Flora :—

Mutinus bambusinus, *Queletia mirabilis*, *Lysurus australiensis*, and *Phallus imperialis* : *Aseroe rubra* may be disregarded, as it occured in a stove at Kew.

Phallus imperialis should be deleted from the list. It is nothing more than *P. iosmos*, which Berkeley described from a figure in Curtis's Entomology (1833).

Mutinus bambusinus, a species common in the eastern tropics, has regularly occurred at Sunningdale under *Arundinaria japonica* for about forty years. It is said not to have been found until the *Arundinaria* was moved about ten years or so after its introduction.

Queletia mirabilis is a very puzzling fungus. It has been recorded only five times—three of these from France, once from U.S.A., and once from England. The last occurred in 1893, outside the Herbarium at Kew, where the packing which had contained some of the American specimens had been thrown earlier in the year. The habitat is usually a tan-bed, but the origin is unknown. C. G. Lloyd suggested that the fungus is a native of South America and that the spores have been carried with hides.

Lysurus australiensis occurred in 1902 at Kidderminster in a field adjacent to a flour mill near a spot where refuse had been emptied out of sacks. A second gathering of *Lysurus* was made near Manchester in 1908, and a third on stable refuse at Chiswick in 1916 and 1917. These later gatherings were referred to *Lysurus borealis*, a North American species which is usually regarded as introduced.

Thus of these *Mutinus bambusinus* is the only one which can be regarded as established.

We are on more certain ground when we turn to microscopic fungi which cause well-marked diseases of cultivated plants. Here we can say with some assurance that the disease was first noticed about a certain date—but there always remains the possibility that the fungus may have been present previously in a more or less dormant state, and that for some reason or other it then became virulent.

(There are also the fungi which occur on host plants not previously cultivated in this country, but these raise special aspects of the problem.)

During recent years several well-marked diseases have made their appearance, some being obviously introduced from America, others being of unknown origin.

Amongst the first may be considered :—

The American Gooseberry Mildew (*Sphaerotheca mors-uvae*), which was introduced into Europe early in the century and is said to have appeared first in Northern Ireland about 1900. It was found in England shortly afterwards, and caused grave concern amongst growers.

The Oak Mildew (*Microsphaera quercina* : *Oidium alphitoides*) was first noticed in Europe in 1907, possibly in Portugal, though it appeared in England much about the

same time. It is known here only in the conidial stage, but the perfect stage has been found several times on the Continent. The fungus occurs also rarely on Beech and Chestnut.

A fungus causing defoliation of Douglas Fir—*Rhabdocline Pseudotsugae*—has been found attacking *P. Douglasii* and *P. glauca* both in Scotland and England. Though the fungus was not described until 1922, the American material was collected in 1911 ; that of Scotland in 1926.

Another American introduction is a rust on *Mahonia*, *Puccinia mirabilissima*, well known in North America. It was found in Perthshire in 1922, and afterwards in Wales and England.

The most recent of these American introductions is the Snap-Dragon Rust, *Puccinia Antirrhini*. This causes great damage in America, but no proper record exists for this country until the hot summer of 1933 when there were numerous outbreaks in the south of England.

It will be obvious that all these diseases might have been brought in with imported plants, and, moreover, except *Rhabdocline*, the fungi concerned have long been known.

There are a few instances, however, where the problem is much more difficult of solution.

The wart disease of Potatoes caused by *Synchytrium* (*Chrysophlyctis*) *endobioticum* was described from Hungary in 1896 and found first in this country in Cheshire in 1900. It spread rapidly and was made a notifiable disease. It now occurs in America and South Africa.

The so-called Dutch Elm Disease (*Ceratostomella* (*Graphium*) *Ulmi*) was first detected as a destructive disease in Holland about 1919. It was found near London in 1927, but for various reasons has not caused the havoc that was feared.

A leaf spot of Dahlias (*Entyloma Dahliae*) was recorded from Belgium in 1916. It has caused considerable damage in this country since 1927.

A well-marked fungus which was described from Petrograd in 1926 as *Naumovia abundans*, growing on *Prunella vulgaris*, was collected in Perthshire in 1912, and abundantly in many parts since. It has also been found in America.

A year or so ago a fungus of considerable economic importance occurred in this country in canned and bottled fruits of various kinds. It was described as *Byssochlamys fulva* and has since been found in the wild, e.g. on old strawberry plants.

What is the explanation of the last few examples ? Are we to suppose that the fungus has been lying quietly and then suddenly burst into activity ? Does the fact that it is noticed in a certain country first mean anything ? Did the fungus originate there and then gradually spread, or did

it waken up more or less at the same time over a wide area possibly by a kind of saltation ?

There is the problem of origin—*Bysssochlamys* indicates that it concerns saprophytes as well as parasites—and the problem of spread. Perhaps regarding the latter nothing need be added to the statement that the same host plant whether wild or cultivated has much the same parasites the world over.

Professor F. E. Weiss thought that both in the case of the faunas and floras further detailed investigations of definite species was essential. He referred to the extensive enquiry made by Mr. Ronald Good into the fluctuating occurrence of the Lizard Orchid (*Himantoglossum hircinum*). Mr. Good had found that during the latter half of the 19th century the number of records and therefore probably the number of specimens of this Orchid greatly diminished, so that it was feared that this plant was fast disappearing. Since the beginning of the century, however, the records have been gradually increasing, so that at present the plant has completely re-established itself in its old localities, and has been also found in new areas. From a consideration of climatic changes which have taken place in the present century as compared with the climatic conditions of the latter half of the 19th century, Mr. Good inclines to the belief that the fluctuation in the number of plants of *Himantoglossum* may be correlated with the climatic changes.

The President pointed out that the increase or diminution in the numbers of certain species, both of animals and of plants, was clearly associated with changes in the environment due to human interference. In other cases, however, this association was far from clear, and nearly all the speakers had referred to instances where no probable cause could be suggested for changes in the abundance of species. It should be remembered that a 'state of nature' was not a fixed and stable thing, but rather a swaying balance of opposing forces, in which now one, and now another, species might have the upper hand. Even if the British Isles had been without human inhabitants it was probable that fifty years might have seen changes similar in kind to, although perhaps less in extent than, those that had been recorded by the various speakers.